



Marine High Risk Site Surveillance Programme

**Annual Synopsis Report for all High Risk Sites 2017–18
(SOW18048)**

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By Chris Woods, Kimberley Seaward, Lily Pryor Rodgers and Graeme Inglis

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Requests for further copies should be directed to:

Publications Logistics Officer
Ministry for Primary Industries
PO Box 2526
WELLINGTON 6140

Email: brand@mpi.govt.nz
Telephone: 0800 00 83 33
Facsimile: 04-894 0300

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Executive Summary

The Marine High Risk Site Surveillance (MHRSS) is a national programme of surveys targeted at the early detection of high-risk marine non-indigenous species (NIS). The primary objective of the MHRSS programme is to detect incursions of New-to-New Zealand non-indigenous organisms listed on the Unwanted Organisms Register in New Zealand ports and marinas previously identified as the highest risk for the introduction and establishment of marine NIS. The programme has two secondary objectives: (i) to detect incursions of marine NIS or cryptogenic organisms not previously recorded in New Zealand, and; (ii) to detect range extensions by marine NIS or cryptogenic organisms that are already established in New Zealand waters. The MHRSS programme is designed to detect the presence of five primary (*Asterias amurensis*, *Carcinus maenas*, *Caulerpa taxifolia*, *Eriocheir sinensis* and *Potamocorbula amurensis*) and four secondary (*Arcuatula senhousia*, *Eudistoma elongatum*, *Sabella spallanzanii* and *Styela clava*) target NIS. Each High Risk Site is surveyed bi-annually (hereafter referred to as the Winter and Summer surveys).

This Annual Synopsis Report details the targeted surveillance surveys at the 11 High Risk Sites during the periods June to September 2017 (the Winter 2017 round of surveys) and November 2017 to March 2018 (the Summer 2017–18 round of surveys).

The number of survey locations sampled exceeded the overall MHRSS programme survey targets. A total of 2928 locations (100.6% of target 2903) were surveyed during the Winter 2017 surveys. A total of 2915 locations (100.4% of target 2903) were surveyed during the Summer 2017–18 surveys. No primary target species were detected, but all four secondary target species were detected during both rounds of surveys.

- *Arcuatula senhousia* was detected during the following surveys: Waitematā Harbour (Winter 2017); and Whāngārei Harbour (Winter 2017, Summer 2017–18).
- *Eudistoma elongatum* was detected during the following surveys: Ōpua Marina/Waikare Inlet (Winter 2017, Summer 2017–18); and Whāngārei Harbour (Summer 2017–18).
- *Sabella spallanzanii* was detected during the following surveys: Lyttelton Harbour/Whakaraupō (Summer 2017–18); Picton Harbour (Winter 2017); Waitematā Harbour (Winter 2017, Summer 2017–18); and Whāngārei Harbour (Winter 2017, Summer 2017–18).
- *Styela clava* was detected during the following surveys: Lyttelton Harbour/Whakaraupō (Winter 2017, Summer 2017–18); Nelson Harbour (Winter 2017, Summer 2017–18); Ōpua Marina/Waikare Inlet (Winter 2017, Summer 2017–18); Otago Harbour (Winter 2017, Summer 2017–18); Picton Harbour (Winter 2017, Summer 2017–18); Tauranga Harbour (Winter 2017, Summer 2017–18); Waitematā Harbour (Winter 2017, Summer 2017–18); and Whāngārei Harbour (Winter 2017, Summer 2017–18).

These secondary target species have previously been detected at the respective High Risk Sites during MHRSS surveys.

The number of specimens collected and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification per survey ranged from zero to 15. The total numbers of specimens sent to MITS were 40 for the Winter 2017 round, and 44 for the Summer 2017–18 round.

Nine of the 40 specimens sent to MITS from the Winter 2017 surveys were NIS, including the red alga *Grateloupia turuturu* (Nelson Harbour), the colonial ascidian *Didemnum vexillum* (Port Taranaki and Wellington Harbour), the solitary ascidian *Ciona savignyi* (Picton Harbour) and the hydroid *Ectopleura larynx* (Nelson Harbour).

- The record of *D. vexillum* from Port Taranaki represents a range extension (previously recorded in Lyttelton, Nelson, Ōpua Marina/Waikare Inlet, Otago, Picton, Tauranga, Wellington and Whāngārei harbours).
- The record of *C. savignyi* from Picton Harbour represents a range extension (previously recorded in Lyttelton, Nelson and Whāngārei harbours).
- The record of *E. larynx* from Nelson Harbour represents a range extension (previously recorded in Picton, Tauranga, Waitematā and Whāngārei harbours).

Twenty-one of the 44 specimens sent to MITS from the Summer 2017–18 surveys were NIS, including the amphipods *Caprella scauroides* (Whāngārei Harbour) and *Jassa slatteryi* (Whāngārei Harbour), the annelid *Paralepidonotus ampulliferus* (Whāngārei Harbour), the colonial ascidians *Botrylloides giganteum* (Ōpua Marina/Waikare Inlet), *Clavelina lepadiformis* (Lyttelton and Wellington harbours), *Didemnum vexillum* (Wellington Harbour), *Diplosoma listerianum* (Whāngārei Harbour) and *Symplegma brakenhielmi* (Whāngārei Harbour), the solitary ascidians *Ascidella aspersa* (Whāngārei Harbour) and *Ciona savignyi* (Otago, Tauranga and Whāngārei harbours), the bryozoans *Amathia verticillata* (Waitematā Harbour) and *Celleporaria nodulosa* (Waitematā and Whāngārei harbours), the crab *Charybdis (Charybdis) japonica* (Tauranga Harbour), the hydroid *Ectopleura crocea* (Lyttelton Harbour/Whakaraupō), the freshwater macrophyte *Lagarosiphon major* (Nelson Harbour, recorded as a detrital sample), the nudibranchs *Okenia pellucida* (Waitematā Harbour) and *Polycera hedgpethi* (Tauranga Harbour) and the sponge *Halisarca dujardini* (Wellington Harbour).

- The record of *C. scauroides* from Whāngārei Harbour represents a range extension (previously recorded in Waitematā Harbour as a New-to-New Zealand species from the Summer 2016–17 survey).
- The record of *B. giganteum* from Ōpua Marina/Waikare Inlet represents a range extension (previously recorded in Tauranga, Waitematā and Whāngārei harbours).
- The record of *C. lepadiformis* from Lyttelton Harbour/Whakaraupō represents a range extension (previously recorded in Nelson, Picton and Wellington harbours).
- The record of *C. savignyi* from Otago, Tauranga and Whāngārei harbours represents range extensions (previously recorded in Lyttelton, Nelson and Picton (see Winter 2017 above) harbours).
- The record of *C. japonica* from Tauranga Harbour represents a range extension (previously recorded in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours).
- The record of *P. hedgpethi* from Tauranga Harbour represents a range extension (previously recorded in Lyttelton, Ōpua Marina/Waikare Inlet and Picton harbours).

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Introduction

The Marine High Risk Site Surveillance (MHRSS) is a national programme of surveys targeted at the early detection of high-risk marine non-indigenous marine species (NIS), and is part of the Ministry for Primary Industries' (MPI) wider marine biosecurity system. The MHRSS programme, delivered by NIWA under contract to MPI, repeats targeted surveillance surveys developed and undertaken by NIWA in 2002–06 and 2008–present at 11 major New Zealand ports and marinas deemed to be the highest risk for the introduction and establishment of marine NIS (Figure 1). Repeat surveys by an experienced team, the core of which includes observers who have surveyed the sites on multiple occasions (often for several years), builds capability and increases the likelihood of detecting temporal changes in species assemblages. Each site is surveyed in winter and summer each year because some organisms have life cycles that prevent macroscopic detection during certain times of the year.

The 11 High Risk Sites^{1,2} for the MHRSS programme are (from north to south):

1. Ōpua Marina/Waikare Inlet (including waters to the south of Brampton Bank);
2. Whāngārei Harbour (Whāngārei-te-rerenga-parāoa);
3. Waitematā Harbour (Auckland; including the Viaduct Basin, Hobson West Marina area, Westhaven Marina, Bayswater Marina, Devonport and Kauri Point/Te Mātā-rae-o-Mana defence areas);
4. Tauranga Harbour (Te Awanui);
5. Port Taranaki (New Plymouth, Ngāmotu);
6. Wellington Harbour (Te Whanganui-a-Tara);
7. Nelson Harbour (including Port Nelson and Waimea Inlet) (within Te Tai-o-Aorere/Tasman Bay);
8. Picton Harbour (including Shakespeare and Waikawa bays, and Havelock Marina);
9. Lyttelton Harbour/Whakaraupō;
10. Otago Harbour; and
11. Bluff Harbour (Awarua).

¹High Risk Site is the terminology used in the Ministry for Primary Industries Statement of Work for the national Marine High Risk Site Surveillance programme.

²Where appropriate, High Risk Site names follow official names listed in: 1) the New Zealand Gazetteer of place names (<http://www.lin.govt.nz/regulatory/place-names/find-place-name/new-zealand-gazetteer-place-names>); 2) Reed, A.W. (2016, revised by Dowling, P.) *Maori place names: their meanings and origins*, Oratia Books, 152p.; 3) Kā Huru Manu (<http://www.kahurumanu.co.nz/ka-ara-tawhito>); 4) '1000 Māori place names', (<https://nzhistory.govt.nz/culture/maori-language-week/1000-maori-place-names>, Ministry for Culture and Heritage, updated 22-Aug-2017); and 5), and as advised by mana whenua. Otherwise, High Risk Site names follow those listed in the Ministry for Primary Industries Statement of Work for the national Marine High Risk Site Surveillance programme.

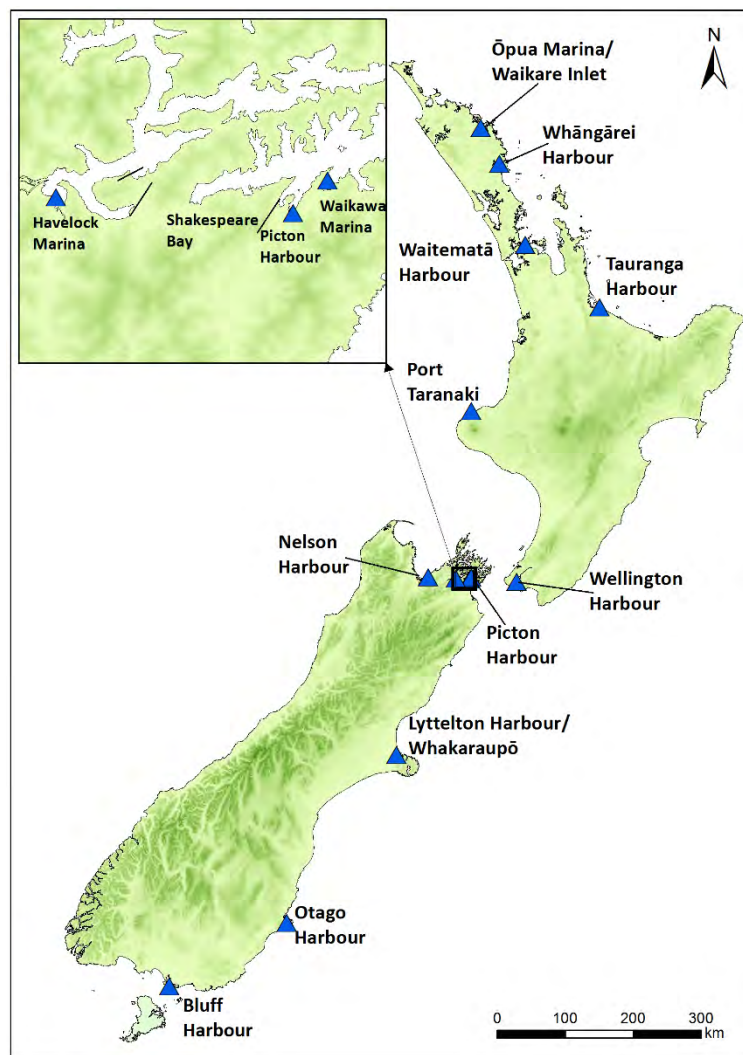


Figure 1: Locations of the 11 High Risk Sites covered by the Marine High Risk Site Surveillance (MHRSS) programme.

Objectives of the Marine High-Risk Site Surveillance programme

The primary objective of the MHRSS programme is:

- To detect incursions of New-to-New Zealand non-indigenous organisms listed on the Unwanted Organisms Register at High Risk Sites throughout New Zealand.

The secondary objectives of the MHRSS programme are:

- To detect incursions of New-to-New Zealand non-indigenous or cryptogenic organisms not listed on the Unwanted Organisms Register at High Risk Sites throughout New Zealand.
- To detect incursions (i.e., range extensions³) of established non-indigenous or cryptogenic organisms that exhibit characteristics of Pests and Diseases.

Target species

MPI has identified five primary target species which are listed on the Unwanted Organisms register.

1. The northern Pacific seastar *Asterias amurensis**.
2. The European green crab *Carcinus maenas**.
3. The green alga *Caulerpa taxifolia**.
4. The Chinese mitten crab *Eriocheir sinensis**.
5. The Asian clam *Potamocorbula amurensis**.

Additionally, four secondary target organisms⁴ are known to be established in New Zealand's coastal waters.

1. The Asian date mussel *Arcuatula senhousia*.
2. The Australian droplet tunicate *Eudistoma elongatum*.
3. The Mediterranean fanworm *Sabella spallanzanii**.
4. The clubbed tunicate *Styela clava*.

*Notifiable organism under Biosecurity (Notifiable Organisms) Order 2016

<http://www.legislation.govt.nz/regulation/public/2016/0073/9.0/whole.html>

This Annual Synopsis Report details the targeted surveillance at the 11 High Risk Sites covered by the MHRSS programme in the survey rounds of Winter 2017 and Summer 2017–18.

³ The term 'range extension' is applied in the context of when a NIS is detected at a geographic location where it has not been documented as previously occurring. As such, range extensions are expansions to the known geographic range of a NIS, but do not implicitly equate to actual geographic spread of an NIS.

⁴ *Didemnum* sp. was removed from the list of secondary target species by MPI in December 2008 (Email from Brendan Gould, MPI/BNZ, to Don Morrissey, NIWA, 12 December 2008). *Sabella spallanzanii* was moved from the primary to the secondary list in June 2011 (MAF Statement of Work for Post Border Surveillance Programmes, National Marine High Risk Site Surveillance Programme – 12099 [10 June 2011]).

Summary of Survey Activity/Methods

Dates of Marine High Risk Site Surveillance programme survey activity

The targeted surveillance surveys of the 11 High Risk Sites covered by the MHRSS programme took place during the periods June⁵ to September 2017 (the Winter 2017 round of surveys) and November 2017 to March 2018 (the Summer 2017–18 round of surveys). Dates for each survey are provided in Table 1.

Table 1: Dates for the Winter 2017 and Summer 2017–18 Marine High Risk Site Surveillance (MHRSS) programme surveys.

High Risk Site	Winter 2017 survey	Summer 2017–18 survey
Bluff Harbour	24–28 July 2017	22–26 January 2018
Lyttelton Harbour/Whakaraupō	11–15 September 2017	5–9 March 2018
Nelson Harbour	24 July–2 August 2017	12–23 February 2018
Ōpua Marina/Waikare Inlet	24 August–1 September 2017	11–15 December 2017
Otago Harbour	19–23 June 2017	6–10 November 2017
Picton Harbour	14–18 and 22 August 2017	13–17 March 2018
Port Taranaki	3–7 July 2017	20–24 November 2017
Tauranga Harbour	12–16 June 2017	22–26 January 2018
Waitematā Harbour	11–22 September 2017	5–16 February 2018
Wellington Harbour	7–11 August 2017	4–15 December 2017
Whāngārei Harbour	14–18 August 2017	6–10 November 2017

Marine High Risk Site Surveillance programme survey techniques

Survey sampling for the MHRSS programme uses a variety of techniques designed to sample a range of soft and hard habitat types such as mud and gravel bottoms, intertidal rocky shores, and artificial structures including marina pontoons, pilings, moorings, jetties and commercial vessel berths. The sampling techniques used were: crab condos; crab (box) traps; benthic sled tows; diver searches; and shore searches. The habitats and species targeted by each sampling technique are detailed in Appendix 1.

A documented process for the selection of sampling methods and allocation of sampling effort for the target species was developed at the start of a previous phase of the MHRSS programme (Inglis et al. 2006a), and included information on the biology and behaviour of the target organisms, as well as sampling methods used for the same or similar species in other parts of their range. Sample plans for the targeted marine pest surveillance programme were developed using a combination of niche models for the target species and particle dispersion models (to simulate dispersal of propagules from the point of release). The niche models were based on Habitat Suitability Indices derived from expert opinion. Their performance was compared with niche models derived statistically from independent data on the distribution of representative non-indigenous species (Inglis et al. 2006b). Sensitivity (efficiency of the survey method), cost-effectiveness, impacts on native species and environments, feasibility and consistency with safe field-working practice were also evaluated in selecting sampling methods. Stochastic Scenario Tree (SST) modelling has also been used

⁵The typical winter MHRSS survey period is May–September, but late completion of the Waitematā Harbour Summer 2016–17 survey (completed in May 2017), due to health and safety concerns regarding the presence of a leopard seal, delayed the start of the 2017 winter survey until June 2017.

to evaluate and optimise confidence of target species detection and identify the resources needed to achieve the required detection outcomes (Morrissey et al. 2012a, b).

Sampling locations for crab (box) trap lines, benthic sled tows and diver searches were pre-allocated prior to each survey by using a grid overlaid on the survey area in a Geographic Information System (GIS). Where a pre-allocated sampling point was not accessible at the time of the survey (e.g., port berth occupied by a vessel, unfavourable weather conditions, port operations underway etc.), the sample was relocated to a nearby suitable location and the new coordinates recorded. Field teams also noted any sampling locations that were not appropriate or were unsafe, so that these could be removed from the grid of potential sampling locations for future surveys. Such locations included areas where high vessel traffic make diving too hazardous, areas that are not suitable for trapping because they are above the low water tide mark or have underwater hazards, seafloor cable zones and other restricted areas.

Specimen identification

All survey samples collected are sorted on-site and taxonomic identities confirmed (where possible) by field team members trained in identification of target species, and who have experience with the biota normally found at each High Risk Site.

Survey specimens to be retained for formal identification include all primary target species, representative samples of secondary target species at locations where they are not currently known to occur (i.e., range extensions) and any suspect organisms whose identities are uncertain. These specimens, preserved in the chemical appropriate to that taxon and with corresponding sampling information (i.e., sample date, location and collection method) are sent to the Marine Invasives Taxonomic Service (MITS) (the centralised, clearinghouse service for taxonomic identification of marine organisms under contract to MPI) immediately following each survey. Species identities are checked for correct naming via the World Register of Marine Species (WoRMS, <http://www.marinespecies.org/>), which provides an authoritative and comprehensive list of names of marine organisms, including information on synonymy.

Any suspected primary target species, suspected non-indigenous or cryptogenic species not previously recorded in New Zealand and range expansions of secondary target species are reported as soon as practicable (within 48 h) by NIWA to MPI, with confirmation as to taxonomic identity provided by MITS to MPI through their contracted reporting procedure. Range extension and New-to-New Zealand status is checked via the Marine Biosecurity Porthole (www.marinebiosecurity.org.nz).

Environmental data collection

Environmental data were recorded at sampling locations during each survey (the principal aim of these records is to develop a database of environmental conditions for each location in the MHRSS programme, rather than conditions associated with each individual sample). The following parameters were measured: water depth; salinity; temperature; water clarity (secchi disk depth); wind direction and speed; time of sampling (to allow determination of tidal stage); and sediment type (for benthic sled sampling).

MPI Marine High Risk Site Surveillance programme team: contacts

The MHRSS programme is administered and funded by MPI's Biosecurity Surveillance Group. Queries relating to the MHRSS programme should be directed to MPI.

The MPI Operational Liaison for MHRSS surveillance activity is Abraham Growcott, Senior Advisor, Marine Surveillance and Incursion Investigation (tel: 04 894 2433, email: Abraham.Growcott@mpi.govt.nz).

NIWA Marine High Risk Site Surveillance programme survey team: contacts

The MHRSS programme surveys were designed by NIWA, and implemented by the NIWA personnel listed in the *Stakeholder communications logs and field team lists* submitted to MPI prior to each MHRSS programme survey. The NIWA Project Manager for the MHRSS programme is Dr Chris Woods (tel: 03 348 8987, email: Chris.Woods@niwa.co.nz).

Results

Sample collection

Total numbers of locations surveyed in each MHRSS programme survey round (Winter 2017 and Summer 2017–18) at each High Risk Site are shown in Table 2. Numbers of survey locations sampled at each High Risk Site generally met, or exceeded the survey targets. A total of 2928 locations (100.6% of target 2903) were surveyed during the Winter 2017 surveys. A total of 2915 locations (100.4% of target 2903) were surveyed during the Summer 2017–18 surveys.

During the Whāngārei Harbour winter survey, the diver search component could not be safely conducted due to leopard seal activity (refer to *Problems encountered during sampling section*), but this was countered with increased benthic sled and shore search sampling effort. A lost crab (box) trap line during the Port Taranaki winter survey resulted in this survey not quite meeting targeted survey effort (99.6% of sampling target achieved). Numbers of locations sampled with each method at each High Risk Site are shown in Appendix 2, by sampling round. The achieved sample locations for each sampling technique at each High Risk Site are shown in Appendix 3, by sampling round.

Table 2: Summary of target and achieved numbers of survey locations sampled at each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site.

High Risk Site	Sampling round	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
Bluff Harbour*	Winter 2017	225	226	100.4
	Summer 2017–18	225	226	100.4
Lyttelton Harbour/Whakaraupō	Winter 2017	243	245	100.8
	Summer 2017–18	243	247	101.6
Nelson Harbour	Winter 2017	243	243	100.0
	Summer 2017–18	243	252	103.7
Ōpua Marina/Waikare Inlet**	Winter 2017	248	248	100.0
	Summer 2017–18	248	250	100.8
Otago Harbour	Winter 2017	243	244	100.4
	Summer 2017–18	243	244	100.4
Picton Harbour	Winter 2017	243	245	100.8
	Summer 2017–18	243	245	100.8
Port Taranaki	Winter 2017	243	242	99.6
	Summer 2017–18	243	244	100.4
Tauranga Harbour	Winter 2017	243	243	100.0
	Summer 2017–18	243	245	100.8
Waitematā Harbour	Winter 2017	486	489	100.6
	Summer 2017–18	486	488	100.4
Wellington Harbour	Winter 2017	243	244	100.4
	Summer 2017–18	243	243	100.0
Whāngārei Harbour	Winter 2017	243	246	101.2
	Summer 2017–18	243	244	100.4
All sites	Winter 2017	2903	2928	100.6
All sites	Summer 2017–18	2903	2915	100.4

*By agreement with MPI, the total target number of sampling locations in Bluff Harbour have been reduced compared to earlier surveys (from 243 down to 225), due to the presence of a sub-surface oyster farm lease north of Tikore Island which has resulted in the immediate area being inaccessible for sampling using crab traps and benthic sled tows. The total number of crab traps and benthic sled locations have been reduced (from 80 to 68, and from 100 to 84, respectively), but the total number of dive locations increased (from 30 to 40), with several of those dives allocated to the oyster farming area.

**By agreement with MPI, the target number of benthic sled locations increased to 105 benthic sled sites following Stochastic Scenario Tree modelling, with increased survey allocation around Hermione Rock (where cruise liners anchor).

Target species collection

Primary target species detected⁶: None.

Secondary target species detected⁷: *Arcuatula senhousia*, *Eudistoma elongatum*, *Sabella spallanzanii* and *Styela clava* were detected during both rounds of surveys (see below).

- *Arcuatula senhousia* was detected during the following surveys: Waitematā Harbour (Winter 2017); and Whāngārei Harbour (Winter 2017, Summer 2017–18).
- *Eudistoma elongatum* was detected during the following surveys: Ōpua Marina/Waikare Inlet (Winter 2017, Summer 2017–18); and Whāngārei Harbour (Summer 2017–18).
- *Sabella spallanzanii* was detected during the following surveys: Lyttelton Harbour/Whakaraupō (Summer 2017–18); Picton Harbour (Winter 2017); Waitematā Harbour (Winter 2017, Summer 2017–18); and Whāngārei Harbour (Winter 2017, Summer 2017–18).
- *Styela clava* was detected during the following surveys: Lyttelton Harbour/Whakaraupō (Winter 2017, Summer 2017–18); Nelson Harbour (Winter 2017, Summer 2017–18); Ōpua Marina/Waikare Inlet (Winter 2017, Summer 2017–18); Otago Harbour (Winter 2017, Summer 2017–18); Picton Harbour (Winter 2017, Summer 2017–18); Tauranga Harbour (Winter 2017, Summer 2017–18); Waitematā Harbour (Winter 2017, Summer 2017–18); and Whāngārei Harbour (Winter 2017, Summer 2017–18).

Number of specimens collected and sent to MITS

The number of specimens sent to the MITS for formal identification per survey ranged from zero to 15. The total numbers of specimens sent were 40 for the Winter 2017 round of surveys, and 44 for the Summer 2017–18 round of surveys (Table 3 and Table 4).

Nine of the 40 specimens sent to MITS from the Winter 2017 surveys were NIS (Table 5), including the red alga *Grateloupia turuturu* (Nelson Harbour), the colonial ascidian *Didemnum vexillum* (Port Taranaki and Wellington Harbour), the solitary ascidian *Ciona savignyi* (Picton Harbour) and the hydroid *Ectopleura larynx* (Nelson Harbour).

- The record of *D. vexillum* from Port Taranaki represents a range extension (previously recorded in Lyttelton, Nelson, Ōpua Marina/Waikare Inlet, Otago, Picton, Tauranga, Wellington and Whāngārei harbours).
- The record of *C. savignyi* from Picton Harbour represents a range extension (previously recorded in Lyttelton, Nelson and Whāngārei harbours).
- The record of *E. larynx* from Nelson Harbour represents a range extension (previously recorded in Picton, Tauranga, Waitematā and Whāngārei harbours).

These range extensions were communicated to MPI through the MITS reporting procedure. The record of the sponge *Polymastia* cf. *aurantia* from Bluff Harbour also represents a range extension for this native species (previously recorded intertidally at the Auckland Islands).

Twenty-one of the 44 specimens sent to MITS from the Summer 2017–18 surveys were NIS (Table 6), including the amphipods *Caprella scauroides* (Whāngārei Harbour) and *Jassa slatteryi* (Whāngārei Harbour), the annelid *Paralepidonotus ampulliferus* (Whāngārei Harbour), the colonial ascidians *Botrylloides giganteum* (Ōpua Harbour), *Clavelina*

⁶*Asterias amurensis*, *Carcinus maenas*, *Caulerpa taxifolia*, *Eriocheir sinensis*, *Potamocorbula amurensis*

⁷*Arcuatula senhousia*, *Eudistoma elongatum*, *Sabella spallanzanii*, *Styela clava*

lepadiformis (Lyttelton and Wellington harbours), *Didemnum vexillum* (Wellington Harbour), *Diplosoma listerianum* (Whāngārei Harbour) and *Symplegma brakenhielmi* (Whāngārei Harbour), the solitary ascidians *Ascidiella aspersa* (Whāngārei Harbour) and *Ciona savignyi* (Otago, Tauranga and Whāngārei harbours), the bryozoans *Amathia verticillata* (Waitematā Harbour) and *Celleporaria nodulosa* (Waitematā and Whāngārei harbours), the crab *Charybdis* (*Charybdis*) *japonica* (Tauranga Harbour), the hydroid *Ectopleura crocea* (Lyttelton Harbour/Whakaraupō), the freshwater macrophyte *Lagarosiphon major* (Nelson Harbour)⁸, the nudibranchs *Okenia pellucida* (Waitematā Harbour) and *Polycera hedgpethi* (Tauranga Harbour) and the sponge *Halisarca dujardini* (Wellington Harbour).

- The record of *C. scauroides* from Whāngārei Harbour represents a range extension (previously recorded in Waitematā Harbour as a New-to-New Zealand species during the Summer 2016–17 survey).
- The record of *B. giganteum* from Ōpua Marina/Waikare Inlet represents a range extension (previously recorded in Tauranga, Waitematā and Whāngārei harbours).
- The record of *C. lepadiformis* from Lyttelton Harbour/Whakaraupō represents a range extension (previously recorded in Nelson, Picton and Wellington harbours).
- The record of *C. savignyi* from Otago, Tauranga and Whāngārei harbours represents range extensions (previously recorded in Lyttelton, Nelson and Picton (see Winter 2017 above) harbours)⁹.
- The record of *C. japonica* from Tauranga Harbour represents a range extension (previously recorded in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours).
- The record of *P. hedgpethi* from Tauranga Harbour represents a range extension (previously recorded in Lyttelton, Ōpua Marina/Waikare Inlet and Picton harbours).

These range extensions were communicated to MPI through the MITS reporting procedure.

⁸ Detected as a detrital sample during a shore search following a storm, and consequent floods and high river flows, in the Nelson region. As an incidental and non-marine NIS, the detection of this freshwater NIS is not mapped within this report.

⁹ *Ciona savignyi* was detected in Marsden Cove Marina during the Winter 2016 MHRSS survey, and recorded as such by the field team, but no sample was taken for formal identification via MITS. Thus, the Summer 2017–18 detection and identification via MITS represents the formal confirmation of the range extension of this NIS into Whāngārei Harbour, although this species appears to have been there since at least 2016.

Table 3: Summary of numbers and types of specimens collected from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification during the Winter 2017 round of surveys.

Organism type	Bluff Harbour	Lyttelton Harbour/Whakaraupō	Nelson Harbour	Ōpua Marina/Waikare Inlet	Otago Harbour	Picton Harbour	Port Taranaki	Tauranga Harbour	Waitematā Harbour	Wellington Harbour	Whāngārei Harbour	Total	% of total
Algae			1					1		4		6	15.0
Annelid	1							1				2	5.0
Amphipod												0	0.0
Anthozoan												0	0.0
Ascidian		1	1			1	3	5	2	5	2	20	50.0
Barnacle												0	0.0
Bivalve										1		1	2.5
Bryozoan												0	0.0
Crab				1			1					2	5.0
Decapod				1						1	2	4	10.0
Echinoderm												0	0.0
Fish	1									1		2	5.0
Gastropod												0	0.0
Hydroid			1									1	2.5
Nudibranch												0	0.0
Sponge	1											1	2.5
Scleractinian												0	0.0
Other	1											1	2.5
Total	4	1	3	2	0	1	4	7	2	12	4	40	100

Table 4: Summary of numbers and types of specimens collected from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification during the Summer 2017–18 round of surveys.

Organism type	Bluff Harbour	Lyttelton Harbour/Whakaraupō	Nelson Harbour	Ōpua Marina/Waikare Inlet	Otago Harbour	Picton Harbour	Port Taranaki	Tauranga Harbour	Waitematā Harbour	Wellington Harbour	Whāngārei Harbour	Total	% of total
Algae			1							8		9	20.5
Annelid											2	2	4.5
Amphipod											5	5	11.4
Anthozoan												0	0.0
Ascidian		1		1	1			1	2	3	6	16	34.1
Barnacle											1	1	2.3
Bivalve												0	0.0
Bryozoan									2		1	3	6.8
Crab								2				2	4.5
Decapod			1									1	2.3
Echinoderm		1										1	2.3
Fish												0	0.0
Gastropod												0	0.0
Hydroid		1										1	2.3
Nudibranch								1	1			2	4.5
Sponge										1		1	2.3
Scleractinian												0	0.0
Other			1									1	2.3
Total	0	3	3	1	1	0	0	4	5	12	15	44	100

Table 5: Specimens collected and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site during the Winter 2017 round of surveys.

Non-indigenous species are in bold type. Specimens are ordered alphabetically by High Risk Site, then by organism type, taxon and (field) sample number. C1 = cryptogenic species category 1. Species previously recorded from New Zealand whose identity as either native or non-indigenous is ambiguous. Also included in this category are newly described species that have exhibited invasive behaviour in New Zealand, but for which there are no known records outside the New Zealand region; Indeterminate = specimens that could not be reliably identified to species level. This group includes: (1) organisms that were damaged, propagule or juvenile stage, and lacked morphological characteristics necessary for identification; and (2) taxa for which there is not sufficient taxonomic or systematic information available to allow identification to species level; NIS = non-indigenous species. Species range extensions are highlighted in blue and marked with an asterisk (*).

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Bluff Harbour	Annelid	<i>Chloeia inermis</i>	Native	BLU25227	73781	Shore search
Bluff Harbour	Fish	<i>Apopterygion oculus</i>	Native	BLU25007	73780	Benthic sled
Bluff Harbour	Other	Mollusc eggs	Indeterminate	BLU25224	73782	Shore search
Bluff Harbour	Sponge	<i>Polymastia</i> cf. <i>aurantia</i> *	Native	BLU25194	73779	Diver search
Lyttelton Harbour/Whakaraupō	Ascidian	<i>Botrylloides leachii</i>	C1	LYT25205b	73810	Diver search
Nelson Harbour	Algae	<i>Grateloupia turuturu</i>	NIS	NSN25198b	73784	Diver search
Nelson Harbour	Ascidian	<i>Botrylloides</i> cf. <i>magnicoecum</i>	Native	NSN25184b	73785	Diver search
Nelson Harbour	Hydroid	<i>Ectopleura larynx</i> *	NIS	NSN25190a	73783	Diver search
Ōpua Marina/Waikare Inlet	Crab	<i>Halicarcinus whitei</i>	Native	OPX25239	73807	Shore search
Ōpua Marina/Waikare Inlet	Decapod	<i>Ogyrides delli</i>	Native	OPX25028	73808	Benthic sled
Picton Harbour	Ascidian	<i>Ciona savignyi</i> *	NIS	PCN25204a	73801	Diver search
Port Taranaki	Ascidian	<i>Didemnum vexillum</i>	NIS	NPL25190b	73770	Diver search
Port Taranaki	Ascidian	<i>Didemnum vexillum</i>	NIS	NPL25194a	73768	Diver search
Port Taranaki	Ascidian	<i>Lissoclinum notti</i>	Native	NPL25199a	73769	Diver search
Port Taranaki	Crab	Brachyura	Indeterminate	NPL25007	73767	Benthic sled
Tauranga Harbour	Algae	<i>Pterocladia</i> sp.	Native	TRG25067	73742	Benthic sled
Tauranga Harbour	Annelid	<i>Acromegalomma suspiciens</i>	Native	TRG25197	73746	Diver search
Tauranga Harbour	Ascidian	<i>Botrylloides leachii</i>	C1	TRG25193	73743	Diver search
Tauranga Harbour	Ascidian	<i>Asterocarpa humilis</i>	C1	TRG25205	73763	Diver search
Tauranga Harbour	Ascidian	<i>Botrylloides leachii</i>	C1	TRG25205	73765	Diver search
Tauranga Harbour	Ascidian	<i>Microcosmus squamiger</i>	C1	TRG25205	73764	Diver search

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Tauranga Harbour	Ascidian	<i>Pyura</i> sp.	Indeterminate	TRG25205	73747	Diver search
Waitematā Harbour	Ascidian	<i>Aplidium phortax</i>	C1	AKL25448	73825	Shore search
Waitematā Harbour	Ascidian	<i>Botrylloides leachii</i>	C1	AKL25375	73824	Diver search
Wellington Harbour	Algae	<i>Callithamnion</i> sp.	Indeterminate	WLG25200	73790	Diver search
Wellington Harbour	Algae	<i>Callophyllis angustifrons</i>	Native	WLG25024	73794	Benthic sled
Wellington Harbour	Algae	<i>Callophyllis angustifrons</i>	Native	WLG25091	73795	Benthic sled
Wellington Harbour	Algae	<i>Grateloupia</i> sp.	Indeterminate	WLG25198	73792	Diver search
Wellington Harbour	Ascidian	<i>Didemnum vexillum</i>	NIS	WLG25182	73791	Diver search
Wellington Harbour	Ascidian	<i>Didemnum vexillum</i>	NIS	WLG25187	73788	Diver search
Wellington Harbour	Ascidian	<i>Didemnum vexillum</i>	NIS	WLG25190	73796	Diver search
Wellington Harbour	Ascidian	<i>Didemnum vexillum</i>	NIS	WLG25195	73797	Diver search
Wellington Harbour	Ascidian	<i>Lissoclinum notti</i>	Native	WLG25201	73789	Diver search
Wellington Harbour	Bivalve	<i>Ennucula strangei</i>	Native	WLG25019	73793	Benthic sled
Wellington Harbour	Decapod	<i>Pterygosquilla schizodontia</i>	Native	WLG25112	73786	Crab trap
Wellington Harbour	Fish	<i>Gnathophis habenatus</i>	Native	WLG25131	73787	Crab trap
Whāngārei Harbour	Ascidian	<i>Botrylloides leachii</i>	C1	WRE25056	73804	Shore search
Whāngārei Harbour	Ascidian	<i>Pseudodistoma opacum</i>	Native	WRE25236	73805	Benthic sled
Whāngārei Harbour	Decapod	<i>Alpheus novaezealandiae</i>	Native	WRE25054	73802	Benthic sled
Whāngārei Harbour	Decapod	<i>Heterosquilla koning</i>	Native	WRE25100	73803	Benthic sled

Table 6: Specimens collected and sent to the Marine Invasives Taxonomic Service (MITS) for formal identification from each Marine High Risk Site Surveillance (MHRSS) programme High Risk Site during the Summer 2017–18 round of surveys.

Non-indigenous species are in bold type. Specimens are ordered alphabetically by High Risk Site, then by organism type, taxon and (field) sample number. C1 = cryptogenic species category 1. Species previously recorded from New Zealand whose identity as either native or non-indigenous is ambiguous. Also included in this category are newly described species that have exhibited invasive behaviour in New Zealand, but for which there are no known records outside the New Zealand region; Indeterminate = specimens that could not be reliably identified to species level. This group includes: (1) organisms that were damaged, propagule or juvenile stage, and lacked morphological characteristics necessary for identification; and (2) taxa for which there is not sufficient taxonomic or systematic information available to allow identification to species level; NIS = non-indigenous species. Species range extensions are highlighted in blue and marked with an asterisk (*).

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Lyttelton Harbour/Whakaraupō	Ascidian	<i>Clavelina lepadiformis</i> *	NIS	LYT26210a	73921	Diver search
Lyttelton Harbour/Whakaraupō	Echinoderm	<i>Allostichaster polyplax</i>	Native	LYT26215	73923	Crab condo
Lyttelton Harbour/Whakaraupō	Hydroid	<i>Ectopleura crocea</i>	NIS	LYT26188b	73922	Diver search
Nelson Harbour	Algae	<i>Myriophyllum triphyllum</i>	Native	NSN26243	73914	Shore search
Nelson Harbour	Decapod	<i>Heterosquilla tricarinata</i>	Native	NSN26236	73907	Shore search
Nelson Harbour	Other	<i>Lagarosiphon major</i>	NIS	NSN26243	73906	Shore search
Ōpua Marina/Waikare Inlet	Ascidian	<i>Botrylloides giganteum</i> *	NIS	OPX26188	73874	Diver search
Otago Harbour	Ascidian	<i>Ciona savignyi</i> *	NIS	DUD26196	73848	Diver search
Tauranga Harbour	Ascidian	<i>Ciona savignyi</i> *	NIS	TRG26196	73889	Diver search
Tauranga Harbour	Crab	<i>Charybdis (Charybdis) japonica</i> *	NIS	TRG26126	73891	Crab trap
Tauranga Harbour	Crab	<i>Ebalia tuberculosa</i>	Native	TRG26045	73890	Benthic sled
Tauranga Harbour	Nudibranch	<i>Polycera hedgpethi</i> *	NIS	TRG26210	73924	Diver search
Waitematā Harbour	Ascidian	<i>Didemnum incanum</i>	Native	AKL26433	73908	Diver search
Waitematā Harbour	Ascidian	<i>Polycarpa zeteta</i>	Native	AKL26462	73910	Diver search
Waitematā Harbour	Nudibranch	<i>Okenia pellucida</i>	NIS	AKL26456	73909	Diver search
Waitematā Harbour	Bryozoan	<i>Amathia verticillata</i>	NIS	AKL26450	73912	Diver search
Waitematā Harbour	Bryozoan	<i>Celleporaria nodulosa</i>	NIS	AKL26450	73911	Diver search
Wellington Harbour	Algae	Bacillariophyceae (diatoms)	Indeterminate	WLG26186b	73902	Diver search
Wellington Harbour	Algae	Bacillariophyceae (diatoms)	Indeterminate	WLG26202b	73904	Diver search
Wellington Harbour	Algae	<i>Cladophora</i> sp.	Indeterminate	WLG26186b	73900	Diver search

High Risk Site	Organism type	Taxon	Biosecurity status	Sample number	MITS code	Survey method
Wellington Harbour	Algae	<i>Codium fragile</i>	Native	WLG26202a	73881	Diver search
Wellington Harbour	Algae	Ectocarpaceae	Indeterminate	WLG26186b	73901	Diver search
Wellington Harbour	Algae	Ectocarpaceae	Indeterminate	WLG26202b	73903	Diver search
Wellington Harbour	Algae	<i>Polysiphonia</i> sp.	Indeterminate	WLG26186b	73879	Diver search
Wellington Harbour	Algae	<i>Polysiphonia</i> sp.	Indeterminate	WLG26202b	73880	Diver search
Wellington Harbour	Ascidian	<i>Clavelina lepadiformis</i>	NIS	WLG26186b	73878	Diver search
Wellington Harbour	Ascidian	<i>Didemnum</i> sp.	Indeterminate	WLG26187a	73883	Diver search
Wellington Harbour	Ascidian	<i>Didemnum vexillum</i>	NIS	WLG26192a	73882	Diver search
Wellington Harbour	Sponge	<i>Halisarca dujardini</i>	NIS	WLG26203a	73877	Diver search
Whāngārei Harbour	Amphipod	<i>Aora</i> aff. <i>typica</i>	C1	WRE26236	73863	Shore search
Whāngārei Harbour	Amphipod	<i>Caprella scauroides</i> *	NIS	WRE26236	73858	Shore search
Whāngārei Harbour	Amphipod	<i>Jassa slatteryi</i>	NIS	WRE26236	73861	Shore search
Whāngārei Harbour	Amphipod	<i>Paradexamine pacifica</i>	Native	WRE26236	73860	Shore search
Whāngārei Harbour	Amphipod	<i>Stenothoe moe</i>	Native	WRE26236	73862	Shore search
Whāngārei Harbour	Annelid	<i>Paralepidonotus ampulliferus</i>	NIS	WRE26058	73857	Benthic sled
Whāngārei Harbour	Annelid	<i>Salmacina australis</i>	Native	WRE26088	73851	Benthic sled
Whāngārei Harbour	Ascidian	<i>Aplidium powelli</i>	Native	WRE26183	73853	Diver search
Whāngārei Harbour	Ascidian	<i>Aplidium powelli</i>	Native	WRE26184	73850	Diver search
Whāngārei Harbour	Ascidian	<i>Asciidiella aspersa</i>	NIS	WRE26182	73854	Diver search
Whāngārei Harbour	Ascidian	<i>Ciona savignyi</i> *	NIS	WRE26182	73864	Diver search
Whāngārei Harbour	Ascidian	<i>Diplosoma listerianum</i>	NIS	WRE26202	73855	Diver search
Whāngārei Harbour	Ascidian	<i>Symplegma brakenhielmi</i>	NIS	WRE26205	73849	Diver search
Whāngārei Harbour	Barnacle	<i>Notomegabalanus decorus</i>	Native	WRE26088	73852	Benthic sled
Whāngārei Harbour	Bryozoan	<i>Celleporaria nodulosa</i>	NIS	WRE26191	73856	Diver search

Distribution of target and non-target species

Distribution maps were plotted for target, and non-target NIS in the following categories¹⁰: species that have expanded their ranges (i.e., range extensions, according to Marine Biosecurity Porthole records); and those that currently have a restricted distribution. The maps show locations where each species was detected and locations where it was absent (Appendix 4), based on appropriate sampling methods for each species (see Appendix 1).

Species plotted (and the survey methods by which they might be collected) are:

Acentrogobius bifrenatus (benthic sled, crab trap, diver search); *Amathia verticillata* (benthic sled, diver search, shore search); *Arcuatula senhousia* (benthic sled, diver search); *Arenigobius bifrenatus* (benthic sled, crab trap, diver search); *Asciidiella aspersa* (benthic sled, diver search, shore search); *Botrylloides giganteum* (benthic sled, diver search, shore search); *Caprella mutica* (diver search, shore search); *Caprella scauroides* (diver search, shore search); *Celleporaria nodulosa* (benthic sled, diver search, shore search); *Charybdis* (*Charybdis*) *japonica* (benthic sled, crab trap, crab condo, diver search, shore search); *Ciona* spp.¹¹ (benthic sled, diver search, shore search); *Clavelina lepadiformis* (benthic sled, diver search, shore search); *Didemnum vexillum* (benthic sled, diver search, shore search); *Diplosoma listerianum* (benthic sled, diver search, shore search); *Ectopleura* spp.¹² (benthic sled, diver search, shore search); *Eudistoma elongatum* (benthic sled, diver search, shore search); *Grateloupia turuturu* (benthic sled, diver search, shore search); *Halisarca dujardinii* (benthic sled, diver search, shore search); *Jassa slatteryi* (diver search, shore search); *Limaria orientalis* (benthic sled); *Metapenaeus bennettiae* (benthic sled, crab condo, crab trap); *Okenia pellucida* (diver search, shore search); *Omobranchus anolius* (benthic sled, crab condo, crab trap, diver search, shore search); *Paralepidonotus ampulliferus* (benthic sled, diver search, shore search); *Polyandrocarpa zorritensis* (benthic sled, diver search, shore search); *Polycera hedgpethi* (diver search, shore search); *Pyromaia tuberculata* (benthic sled, crab trap); *Sabella spallanzanii* (benthic sled, crab trap, diver search, shore search); *Styela clava* (benthic sled, crab trap, diver search, shore search); *Symplegma brakenhielmi* (benthic sled, diver search, shore search); *Theora lubrica* (benthic sled); *Tritia burchardi*¹³ (benthic sled, crab trap, crab condo, diver search, shore search); and *Undaria pinnatifida* (benthic sled, crab trap, diver search, shore search). Records are shown for both the Winter 2017 and Summer 2017–18 survey rounds.

Secondary target non-indigenous species

Arcuatula senhousia

Detected (predominantly in benthic sled tows) in Whāngārei Harbour during both surveys and Waitematā Harbour during the winter survey. Distributions within each High Risk Site were as follows:

- Waitematā Harbour: Te Wai-o-Pareira/Henderson Creek; and Whau River channel. Recorded at a total of 2 out of 489 (0.4%) sampling locations during the winter survey. This reflects a continued sparse distribution and abundance relative to other recent MHRSS surveys.

¹⁰ There were no new species records for New Zealand (i.e., New-to-New Zealand species) for the Winter 2017 and Summer 2017–18 survey rounds.

¹¹ Includes *Ciona intestinalis* and *C. savignyi*. Both are NIS that have been recorded previously in New Zealand. There are no native *Ciona* spp. in New Zealand. Further differentiation as to the extent of the presence of both NIS at MHRSS High Risk Sites is ongoing. Where siphon pigmentation is present, physical differentiation between *C. intestinalis* and *C. savignyi* in the field is possible and has been confirmed via expert formal identification.

¹² Includes *Ectopleura crocea* and *E. larynx*. Both are NIS that have been recorded previously in New Zealand. There are native *Ectopleura* spp. in New Zealand, but their polyp colouration is markedly different, allowing *E. crocea* and *E. larynx* to be differentiated from the natives. Further differentiation as to the extent of the presence of both NIS at MHRSS High Risk Sites is ongoing. Physical differentiation between *E. crocea* and *E. larynx* in the field is problematic and requires formal expert identification.

¹³ Formerly known as *Nassarius burchardi*.

- Whāngārei Harbour: Hātea River channel; Matakohe (Limestone Island); Portland Reach; Wellington Reach; Tamaterau Reach; and Marsden Cove Marina. Recorded at a total of 17 out of 246 (6.9%) sampling locations during the winter survey, and at 11 out of 244 (4.5%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys, apart from the more limited distribution recorded in the Winter 2014 and Summer 2014–15 survey rounds, when there were no detections in the lower harbour or Marsden Cove Marina.

Eudistoma elongatum

Eudistoma elongatum was detected (predominantly during diver and shore searches) in Ōpua Marina/Waikare Inlet during both surveys and the summer survey of Whāngārei Harbour.

Distributions within each High Risk Site were as follows:

- Ōpua Marina/Waikare Inlet: Russell; Toretore Island; Paihia; Pomare Bay; Tapu Point; Ōpua Wharf; and Ōpua Marina. Recorded at a total of 44 out of 248 (17.7%) sampling locations during the winter survey, and at 38 out of 250 (15.2%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys.
- Whāngārei Harbour: Kissing Point Marina; and Port Nikau. Recorded at a total of 5 out of 244 (2.1%) sampling locations during the summer survey. This reflects a slightly reduced distribution relative to other recent MHRSS surveys, with no detections in the lower harbour.

Sabella spallanzanii

Sabella spallanzanii was detected (predominantly during diver and shore searches) in Waitematā and Whāngārei harbours during both surveys, the winter survey of Picton Harbour and the summer survey Lyttelton Harbour/Whakaraupō. Distributions within each High Risk Site were as follows:

- Lyttelton Harbour/Whakaraupō: Oil Berth (as a single specimen). Recorded at a total of 1 out of 247 (0.4%) sampling locations. This reflects a continued sparse distribution and abundance relative to other recent MHRSS surveys after a delimitation and removal programme commissioned by MPI in 2008–09 following its detection here as a New-to-New Zealand NIS during the Lyttelton Summer 2008 MHRSS survey.
- Picton Harbour: Picton Marina (as hull-fouling on a recreational launch). All visible *Sabella* were removed from the launch for disposal to landfill, and the vessel was removed from the water for cleaning by the vessel owner in liaison with MPI and Marlborough District Council (MDC). Recorded at a total of 1 out of 245 (0.4%) sampling locations. This reflects a continued sparse distribution and abundance at this site's marinas (Picton and Waikawa) relative to other recent MHRSS surveys. This species has been subject to delimitation and removal surveys by MDC and the Top of the South Biosecurity Partnership.
- Waitematā Harbour: main channels in the upper and lower harbour from Harrier Point out to the harbour entrance; West Park Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Hobson Bay Marina; and Ōrākei Marina. Recorded at a total of 154 out of 489 (31.5%) sampling locations during the winter survey, and at 160 out of 488 (32.8%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys.
- Whāngārei Harbour: Kissing Point Marina; Port Nikau; Parua Bay; Marsden Cove Marina; and Marsden Point (the furthest detection out to the harbour entrance to date). Recorded at a total of 3 out of 246 (1.2%) sampling locations during the winter survey, and at 36 out of 244 (14.8%) sampling locations during the summer survey.

This reflects a similar distribution and abundance relative to other recent MHRSS surveys, with marked seasonality in detection (i.e., greater distribution and abundance detected in summer surveys). This species has been subject to delimitation and removal surveys by Northland Regional Council (NRC).

Styela clava

Styela clava was detected (predominantly during diver and shore searches) in Lyttelton, Nelson, Ōpua Marina/Waikare Inlet, Otago, Picton, Tauranga, Waitematā and Whāngārei harbours during both surveys. Several instances of *S. clava* being recorded attached to masking crabs (*Notomithrax* spp.) were noted (i.e., potential dispersal vectors). Distributions within each High Risk Site were as follows:

- Lyttelton Harbour/Whakaraupō: throughout the upper harbour; Governors Bay; Quail Island; Charteris Bay; Magazine Bay Marina; Port of Lyttelton; Cashin Quay; Diamond Harbour; and Purau Bay. Recorded at a total of 37 out of 245 (15.1%) sampling locations during the winter survey, and at 58 out of 247 (23.5%) sampling locations during the summer survey. This reflects a similar abundance relative to other recent MHRSS surveys, but increasing distribution along the southern side of the harbour.
- Nelson Harbour: Haulashore Island; harbour entrance; Port Nelson; Slipway Basin; Nelson Marina; and Nelson Haven. Recorded at a total of 50 out of 243 (20.6%) sampling locations during the winter survey, and at 50 out of 252 (19.8%) sampling locations during the summer survey. This reflects the continued increase in distribution and abundance relative to other recent MHRSS surveys.
- Ōpua Marina/Waikare Inlet: Waitangi; Paihia; Russell; Pomare Bay; Motuarahi Island; Toretore Island; Ōpua Wharf; Ōpua Marina; Okiato Point; and Tapu Point. Recorded at a total of 40 out of 248 (16.1%) sampling locations during the winter survey, and at 59 out of 250 (23.6%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys.
- Otago Harbour: the very upper harbour margin; Port Otago to Ravensbourne Wharf; Burns Point; and Raynbirds Bay. Recorded at a total of 28 out of 244 (11.5%) sampling locations during the winter survey, and at 30 out of 244 (12.3%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys.
- Picton Harbour: Waikawa Marina. Recorded at a total of 4 out of 245 (1.6%) sampling locations during the winter survey, and 2 out of 245 (0.8%) sampling locations during the summer survey. This reflects a similar sparse distribution and abundance relative to other recent MHRSS surveys following its first detection here as a range extension during the Winter 2014 survey, and a subsequent delimitation and removal survey in June 2014 commissioned by MDC and MPI, and subsequent removal surveys by MDC and the Top of the South Biosecurity Partnership.
- Tauranga Harbour: western channel near Rangiwaea Island (the furthest westwards detection to date in the harbour); Port of Tauranga; Tauranga Bridge Marina; and Trinity Wharf. Recorded at a total of 10 out of 243 (4.1%) sampling locations during the winter survey, and at 5 out of 245 (2.0%) sampling locations during the summer survey. This reflects a similar sparse distribution and abundance relative to other recent MHRSS surveys. This species has been subject to delimitation and removal surveys by Bay of Plenty Regional Council (BOPRC).
- Waitematā Harbour: throughout the upper and lower harbour; Pinetree Point; Harrier Point; Kauri Point/Te Mātā-rae-o-Mana; Chelsea Wharf; Westpark Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Devonport Wharf; Hobson Bay Marina; and Ōrākei Marina.

Recorded at a total of 92 out of 489 (18.8%) sampling locations during the winter survey, and at 55 out of 488 (11.3%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys.

- Whāngārei Harbour: Port Nikau; and Marsden Cove Marina. Recorded at a total of 1 out of 246 (0.4%) sampling locations during the winter survey, and at 20 out of 244 (8.2%) sampling locations during the summer survey. This reflects a similar distribution and abundance relative to other recent MHRSS surveys. This species has been subject to delimitation and removal surveys by NRC.

Non-target, non-indigenous species

Acentrogobius pflaumii

Detected in Whāngārei Harbour during the summer survey at Port Nikau.

Amathia verticillata

Detected in Tauranga Harbour during both surveys and Nelson and Waitematā harbours during the summer survey.

- Nelson Harbour: Port Nelson; Nelson Marina; and Nelson Haven.
- Tauranga Harbour: Ōmokoroa Beach; Motuhua Island; Tauranga Marina; Port of Tauranga; and Trinity Wharf.
- Waitematā Harbour: Westhaven Marina.

Arenigobius bifrenatus

Detected in the Whāngārei Harbour during the summer survey at Town Basin Marina.

Ascidella aspersa

Detected in Otago Harbour during the winter survey and Whāngārei Harbour during the summer survey.

- Otago Harbour: Port Otago; Leith Marina; and Black Jacks Point.
- Whāngārei Harbour: Marsden Cove Marina.

Botrylloides giganteum

Detected in Ōpua Marina/Waikare Inlet during the summer survey at Ōpua Wharf. This represents a range extension into Ōpua Marina/Waikare Inlet (previously recorded in Tauranga, Waitematā and Whāngārei harbours).

Caprella mutica

Detected in Lyttelton Harbour/Whakaraupō during both surveys at Magazine Bay Marina, Port of Lyttelton and Purau Bay.

Caprella scauroides

Detected in Whāngārei Harbour during the summer survey at McLeod Bay. This represents a range extension into Whāngārei Harbour (previously recorded in Waitematā Harbour as a New-to-New Zealand species during the Summer 2016–17 survey).

Celleporaria nodulosa

Detected in Waitematā and Whāngārei harbours during the summer survey.

- Waitematā Harbour: near Kauri Point/Te Mātā-rae-o-Mana; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; Hobson Bay Marina; and Ōrākei Marina.

- Whāngārei Harbour: Port Nikau.

Charybdis (Charybdis) japonica

Detected in Waitematā and Whāngārei harbours during both surveys, Ōpua Marina/Waikare Inlet during the winter survey and Tauranga Harbour during the summer survey (two specimens; one mature male and one mature female crab). This represents a range extension into Tauranga Harbour (previously recorded in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours).

- Ōpua Marina/Waikare Inlet: Ōpua Marina.
- Tauranga Harbour: south of Matapihi railway bridge.
- Waitematā Harbour: near Kauri Point/Te Mātā-rae-o-Mana; near Birkenhead Wharf; Port of Auckland; and Ōrākei Marina.
- Whāngārei Harbour: upper and lower harbour; Kissing Point Marina; Port Nikau; near Matakoho (Limestone Island); Portland Reach; Tamaterau Reach; Jacksons Bay; Martin Point; Reserve Point; Munro Bay; and Marsden Cove Marina.

Ciona spp.

Detected in Lyttelton and Nelson harbours during both surveys, Picton Harbour during the winter survey and Tauranga, Waitematā and Whāngārei harbours during the summer survey. The records of *C. savignyi* from Otago (summer), Picton (winter), Tauranga (summer) and Whāngārei (summer) harbours represents range extensions (previously recorded in Lyttelton and Nelson harbours).

- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; Cashin Quay; and Purau Bay.
- Nelson Harbour: Port Nelson; and Nelson Marina.
- Otago Harbour: Port Otago; and Leith Marina (*C. savignyi* detection).
- Picton Harbour: Picton Marina (*C. savignyi* detection).
- Tauranga Harbour: Tauranga Marina (*C. savignyi* detection).
- Waitematā Harbour: Westhaven Marina.
- Whāngārei Harbour: Marsden Cove Marina (*C. savignyi* detection).

Clavelina lepadiformis

Detected in Picton and Nelson harbours during both surveys, Lyttelton and Wellington harbours during the summer survey. This represents a range extension into Lyttelton Harbour/Whakaraupō (previously recorded in Nelson, Picton and Wellington harbours).

- Lyttelton Harbour/Whakaraupō: Purau Bay.
- Nelson Harbour: Nelson Marina.
- Picton Harbour: near the *Edwin Fox* museum; Picton Marina; and Waikawa Marina.
- Wellington Harbour: Seaview Marina.

Didemnum vexillum

Detected in Port Taranaki, Lyttelton, Otago, Tauranga, Wellington and Whāngārei harbours during both surveys, Nelson, Ōpua Marina/Waikare Inlet and Picton harbours during the summer survey. The record of *D. vexillum* from Port Taranaki represents a range extension (previously recorded in Lyttelton, Nelson, Ōpua Marina/Waikare Inlet, Otago, Picton, Tauranga, Wellington and Whāngārei harbours).

- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; Charteris Bay, Diamond Harbour; and Purau Bay.
- Nelson Harbour: Nelson Port.
- Ōpua Marina/Waikare Inlet: Ōpua Wharf.

- Otago Harbour: Port Otago; Ravensbourne Wharf; Port Chalmers; Careys Bay; and Deborah Bay.
- Picton Harbour: Shakespeare Bay; Picton Port; Picton Marina; and Waikawa Marina.
- Port Taranaki: Moturoa Wharf; Newton King Tanker Terminal; Blyde Wharf; and Lee Breakwall.
- Tauranga Harbour: Ōmokoroa Beach; Rangiwaia Island; Matakana Island Wharf; Tauranga Marina; Mount Maunganui swing moorings; Port of Tauranga; Tauranga Bridge Marina; and Town Reach.
- Wellington Harbour: Lambton Harbour; Chaffers Marina; and Miramar Wharf.
- Whāngārei Harbour: Kaiwaka Point; Matakoho (Limestone Island); Marsden Cove Marina; McLeod Bay; and Marsden Point.

Diplosoma listerianum

Detected in Whāngārei Harbour during the summer survey at Marsden Cove Marina.

Ectopleura spp.

Detected in Nelson Harbour during both surveys, Lyttelton, Picton, Tauranga and Waitematā harbours during the summer survey. The record of *E. larynx* from Nelson Harbour represents a range extension (previously recorded in Picton, Tauranga, Waitematā and Whāngārei harbours).

- Lyttelton Harbour/Whakaraupō: Magazine Bay Marina; Port of Lyttelton; and Cashin Quay.
- Nelson Harbour: Nelson Port (*E. larynx* detection).
- Picton Harbour: Waikawa Marina.
- Tauranga Harbour: Port of Tauranga; and Tauranga Bridge Marina.
- Waitematā Harbour: Westpark Marina.

Grateloupia turuturu

Detected in Nelson Harbour during the winter survey at Nelson Marina.

Halisarca dujardinii

Detected in Wellington Harbour during the summer survey at Lambton Harbour (Kings Wharf).

Jassa slatteryi

Detected in Whāngārei Harbour during the summer survey at McLeod Bay.

Limaria orientalis

Detected in Waitematā and Whāngārei harbours during both surveys.

- Waitematā Harbour: main channel in the lower harbour from Kauri Point/Te Mātā-rae-o-Mana to Devonport Naval Base.
- Whāngārei Harbour: Shell Cut Reach; Manganese Point; Reserve Point; and Marsden Cove Marina.

Metapenaeus bennettiae

Detected in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours during both surveys.

- Ōpua Marina/Waikare Inlet: Hutia Creek; Hermione Rock; Kororāreka Point; and Kororāreka Bay.

- Waitematā Harbour: upper and lower harbour; Lucas Creek; Beach Haven; Te Wai-o-Pareira/Henderson Creek; Westpark Marina; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Whakatakataka Bay; and harbour entrance.
- Whāngārei Harbour: upper harbour; Town Basin; Port Nikau; Kioreroa Reach; and Portland Reach.

Okenia pellucida

Detected in Waitematā Harbour during the summer survey at Westhaven Marina.

Omobranchus anolius

Detected in Waitematā Harbour during the summer survey at Westhaven Marina and Port of Auckland.

Paralepidonotus ampulliferus

Detected in Whāngārei Harbour during the summer survey at Portland Reach.

Polyandrocampa zorritensis

Detected in Tauranga Harbour during the summer survey at Tauranga Marina.

Polycera hedgpethi

Detected in Tauranga Harbour during the summer survey at Mount Maunganui North berths of Port of Tauranga. This represents a range extension into Tauranga Harbour (previously recorded in Ōpua Marina/Waikare Inlet, Lyttelton and Picton harbours).

Pyromaia tuberculata

Detected in Ōpua Marina/Waikare Inlet, Waitematā and Whāngārei harbours during both surveys, Port Taranaki and Tauranga Harbour during the summer survey.

- Ōpua Marina/Waikare Inlet: Hermione Rock; Kororāreka Point; and Kororāreka Bay.
- Port Taranaki: near Newton King Terminal.
- Tauranga Harbour: Tauranga Marina; Sulphur Point; Port of Tauranga; and main channel to the north of the Matapihi railway bridge.
- Waitematā Harbour: Te Wai-o-Pareira/Henderson Creek; main channels of the upper and lower harbour; and Westhaven Marina.
- Whāngārei Harbour: Main channels from Kioreroa Reach through lower harbour to Marsden Point.

Symplegma brakenhielmi

Detected in Waitematā Harbour during both surveys and Whāngārei Harbour during the summer survey.

- Waitematā Harbour: main channels in the upper and lower harbour; Westpark Marina; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; and Ōrākei Marina. As in the previous round of surveys this species appears to exhibit a marked seasonality at this site, with increased detections in summer.
- Whāngārei Harbour: Marsden Cove Marina.

Theora lubrica

Detected in Lyttelton, Nelson, Ōpua Marina/Waikare Inlet, Picton, Port Taranaki, Tauranga, Waitematā, Wellington and Whāngārei harbours during both surveys.

- Lyttelton Harbour/Whakaraupō: north-western region of upper harbour from Governors Bay to Cashin Quay breakwall; Magazine Bay; Port of Lyttelton; Charteris Bay; Purau Bay; and harbour entrance.
- Nelson Harbour: Haulashore Island; Port Nelson; Nelson Marina; and Nelson Haven.
- Ōpua Marina/Waikare Inlet: Waitangi; Hermione Rock; Kororāreka Bay; Veronica Channel; and Ōpua Marina.
- Picton Harbour: Havelock Marina; Shakespeare Bay; Port of Picton; and Picton Marina.
- Port Taranaki: main dredged channel of port area inside of the Main Breakwater.
- Tauranga Harbour: western channel near Motuhua Island; near Matakana Island wharf; and Port of Tauranga.
- Waitematā Harbour: upper and lower harbour; Te Wai-o-Pareira/Henderson Creek; Whau River; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Ōrākei Marina; and Ōkahu Bay.
- Wellington Harbour: Lambton Harbour; CentrePort; from Kaiwharawhara past Ngauranga; Evans Bay; Seaview Marina; and Seaview Wharf/Terminal.
- Whāngārei Harbour: Town Basin; Port Nikau; Portland Reach; Parua Bay; and Marsden Cove Marina.

Tritia burchardi

Detected in Waitematā and Whāngārei harbours during both surveys and Ōpua Marina/Waikare Inlet during the winter survey.

- Ōpua Marina/Waikare Inlet: Hutia Creek.
- Waitematā Harbour: upper and lower harbour; Te Wai-o-Pareira/Henderson Creek; Whau River; Westhaven Marina; Bayswater Marina; Viaduct and Hobson West Marina; Port of Auckland; Devonport Naval Base; Ōrākei Marina; and harbour entrance.
- Whāngārei Harbour: upper and lower harbour; Town Basin; Port Nikau; Portland Reach; Kioreroa Reach; Parua Bay; Reserve Point; and Marsden Cove Marina.

Undaria pinnatifida

Detected in Bluff, Lyttelton, Otago, Picton, Port Taranaki, Waitematā and Wellington harbours during both surveys, Nelson Harbour during the winter survey and Tauranga Harbour during the summer survey.

- Bluff Harbour: western side of the harbour up past Tikore Island; main channel; Island Harbour; Fishing Boat Wharves; Tiwai Wharf; Town Wharf; Argyle Beach; and Stirling Point.
- Lyttelton Harbour/Whakaraupō: north-western region of upper harbour from Governors Bay to Cashin Quay breakwall; Magazine Bay; Port of Lyttelton; Quail Island; Charteris Bay; Diamond Harbour; Purau Bay; and near Breeze Bay.
- Nelson Harbour: Haulashore Island; inside the Boulder Bank at the harbour entrance; Main Wharf; Port Nelson; and Nelson Marina. As in previous rounds of surveys this species appears to exhibit a marked seasonality at this site, with increased detections in winter, and few summer detections due to temperature-related dieback.
- Otago Harbour: throughout upper and lower harbour; Port Otago; Leith Marina; Ravensbourne Wharf; Burns Point; Company Bay; Broad Bay; Back Beach; Port Chalmers; Careys Bay; Hamilton Bay; Ōtawhero; and Ōmate Beach.
- Picton Harbour: Shakespeare Bay; Port of Picton; Picton Marina; and Waikawa Marina.
- Port Taranaki: port area; commercial berths (Moturoa and Blyde wharves, and Newton King Tanker Terminal); reclamation; and inside the Lee Breakwater.

- Tauranga Harbour: Tauranga Marina; Sulphur Point; Port Tauranga; and north of the Matapihi railway bridge. As in previous rounds of surveys this species appears to exhibit a marked seasonality at this site, with increased detections in winter, and few summer detections due to temperature-related dieback
- Waitematā Harbour: throughout the upper and lower harbour; Harrier Point; Beach Haven; Kauri Point/Te Mātā-rae-o-Mana; Birkenhead Wharf; Bayswater Marina; Westhaven Marina; Viaduct and Hobson West Marina; Devonport Naval Base; Hobson Bay Marina; and Ōrākei Marina. As in previous rounds of surveys this species appears to exhibit a marked seasonality at this site, with increased detections in winter, and few summer detections due to temperature-related dieback.
- Wellington Harbour: throughout the south-western margin of the harbour from Kaiwharawhara to Point Jerningham; Evans Bay; Miramar Peninsula from Burnham Wharf to Scorching Bay; Seaview Marina; and Seaview Wharf/Terminal.

Discussion

The Winter 2017 and Summer 2017–18 rounds of MHRSS programme surveys exceeded the overall target numbers of survey sampling locations at the 11 High Risk Sites. No primary target species were detected during the surveys. No New-to-New Zealand species were detected. All four secondary target species were detected during the surveys: *Arcuatula senhousia* (Waitematā and Whāngārei harbours); *Eudistoma elongatum* (Ōpua Marina/Waikare Inlet and Whāngārei Harbour); *Sabella spallanzanii* (Lyttelton, Picton, Waitematā and Whāngārei harbours); and *Styela clava* (Lyttelton, Nelson, Ōpua Marina/Waikare Inlet, Otago, Picton, Tauranga, Waitematā, Wellington and Whāngārei harbours). These secondary target species have been recorded at the respective High Risk Sites during previous surveys.

All *S. spallanzanii* found in Lyttelton and Picton harbours were removed and disposed of to landfill. All *S. clava* found in Picton and Tauranga harbours were also removed and disposed of to landfill. Increasing proliferation of *S. clava* in Nelson and Otago harbours meant that collection and disposal at these High Risk Sites was not undertaken during this round (as in all surveys at these sites post Summer 2014–15).

Non-target, NIS of note detected during the MHRSS surveys included the following: *Acentrogobius bifrenatus*; *Amathia verticillata*; *Arenigobius bifrenatus*; *Ascidiella aspersa*; *Botrylloides giganteum* (range extension, detected in Ōpua Marina/Waikare Inlet); *Caprella mutica*; *C. scauroides* (range extension, detected in Whāngārei Harbour); *Celleporaria nodulosa*; *Charybdis (Charybdis) japonica* (range extension, detected in Tauranga Harbour); *Ciona* spp. (range extensions for *C. savignyi*, detected in Otago, Picton, Tauranga and Whāngārei harbours); *Clavelina lepadiformis* (range extension, detected in Lyttelton Harbour/Whakaraupō); *Didemnum vexillum* (range extension, detected in Port Taranaki); *Diplosoma listerianum* (Whāngārei Harbour); *Ectopleura* spp. (range extension for *E. larynx*, detected in Nelson Harbour); *Grateloupia turuturu*; *Halisarca dujardini*; *Jassa slatteryi*; *Limaria orientalis*; *Metapenaeus bennettiae*; *Okenia pellucida*; *Omobranchus anolius*; *Paralepidonotus ampulliferus*; *Polyandrocarpa zorritensis*; *Polycera hedgpethi* (range extension, detected in Tauranga Harbour); *Pyromaia tuberculata*; *Symplegma brakenhielmi*; *Theora lubrica*; *Tritia burchardi*; and *Undaria pinnatifida*.

Recommendations

- Survey sampling techniques as currently employed in the MHRSS programme still reflect international best practice for effective detection of the MHRSS programme primary and secondary target species, and survey results indicate that they are effective at detecting actual and suspect NIS. However, continued evaluation as to their effectiveness in relation to any alternative or emergent detection tools or techniques is advised (see item on molecular probes in the following Innovations/efficiencies section).
- The distribution of sampling effort in Ōpua Marina/Waikare Inlet, as proposed in the revised design report (Morrissey et al, 2012a) and based on stochastic scenario tree modelling (Morrissey et al, 2012b), will continue to be used in future rounds of Ōpua surveys. Stochastic scenario trees were also developed for all other MHRSS programme High Risk Sites (Morrissey et al, 2012b) to estimate the detection sensitivity of different strategies for allocating samples, and to explore the optimisation of sample allocation for individual target species and estimate current levels of sensitivity. This optimisation approach may be applied to other High Risk Sites in the future, pending decisions on potential review of target sites and species by MPI, and will be explored via further discussion with MPI.

Innovations/efficiencies

In 2017–18, NIWA invested in developing the following innovations to help improve surveillance for marine NIS in New Zealand:

- NIWA currently leads a three-year project, funded through the Ministry for Business, Innovation and Employment's International Relationships Fund (C01X1527) to develop enduring collaborations with marine biosecurity scientists in the USA, Canada, Australia. The project has established an international steering group to facilitate information exchange and collaboration among the four countries and involves research scientists from 16 international research organisations, including the Smithsonian Environmental Research Centre, Canadian Government Department of Fisheries and Oceans, Australian Government Department of Agriculture and Water Resources, and the Western Australian Department of Primary Industries and Regional Development.
- NIWA has invested co-funding in the refreshing of the Marine Biosecurity Porthole. The Marine Biosecurity Porthole was created in 2010 as a collaboration between MPI and NIWA to provide greater access to information and data on marine non-indigenous species in New Zealand. The Porthole contains information for over 3,600 native, cryptogenic and non-indigenous marine species with links to over 155,000 individual distribution records. It draws upon data compiled from a range of funded surveys for marine NIS, records reported via the passive surveillance system through MITS, and observations of marine NIS made through taxonomic and ecological research undertaken by NIWA. The Porthole includes an interactive mapping application that allows verified observations on the distribution of non-indigenous species within New Zealand to be displayed, identification guides for non-indigenous and native marine species, videos and information on marine pests and their management, and information on marine biosecurity research being undertaken in New Zealand. The Porthole has recently been redesigned to allow easier access to data downloads and information on marine biosecurity research and management.
- NIWA invested in a three-year PhD scholarship to support research into the use of settlement plates and next generation sequencing for marine surveillance. The aim of this research is to develop high-throughput tools that will allow faster, more cost-efficient use of this method of detection. The PhD candidate is nearing completion of her research, and has started publishing this research (e.g., von Ammon et al., 2018).
- As part of its Strategic Science Investment Fund (SSIF)-funded Marine Biosecurity Programme, NIWA has invested in the development of species-specific molecular markers for a range of key target species (Environmental DNA (eDNA) and RNA (eRNA)). This work has been done in collaboration with researchers at the Cawthron Institute, and the Universities of Canterbury and Otago. In the 2016–17 financial year we field-trialled qPCR assays for the Mediterranean fanworm (*Sabella spallanzanii*) and clubbed tunicate (*Styela clava*) in Nelson and Waitematā harbours (Wood et al., in press). In the 2017–18 financial year, we implemented further sampling trials at six MHRSS High Risk sites that have different levels of infestation by the target species to determine the sensitivity and efficacy of the molecular survey method.
- In response to significant Health and Safety hazards to divers posed by certain dangerous marine megafauna, potential for contact with contaminated waters and dangerous boat traffic, NIWA has developed a low-cost real-time pole-mounted video system (polecam). This system provides the capacity for a shore- or boat-based observer to view underneath marina pontoons and other floating structures, as well as down wharf piles and berth walls to a (current) depth of 5 m. This polecam system has yet to be formally tested for efficacy in comparison to the traditional, and proven, diver search method as currently used in the MHRSS programme.

- NIWA researchers have been using towed camera systems and Remotely Operated Vehicles (ROVs) for a range of benthic surveys in marine and freshwater environments. NIWA currently operates a VideoRay Pro4 inspection-class ROV based in the Nelson office and our marine biosecurity field teams include personnel who have undertaken training to be Certified as a Basic Operator for VideoRay ROVs. We are currently investigating options for applying these ROV technologies to aquatic biosecurity surveillance and vessel inspections. In 2018–19, we plan to invest in additional ROV capability that incorporates high resolution (4K) video streaming for high quality video and still imagery and the ability to operate within complex structures such as wharf piles and the undersides of pontoons. We anticipate undertaking field trials of ROVs for surveillance in the 2018–19 financial year.
- During the MHRSS programme, there have been practical challenges to using ruggedized computers/tablets to collect field data on small boats with saltwater spray/rain, and without hindering survey operational efficiency. Several ruggedized computers/tablets have been trialled and found to be unsatisfactory. Recent developments in software for Android® tablets have led to the possibility of using low-cost tablets in ruggedized cases with mobile network capabilities for GIS and data security. A low-cost tablet was trialled in the Summer 2016–17 survey round, and proved promising. A second tablet has been purchased, and in combination with smartphones equipped with Collector for ArcGIS, further development of electronic data capture specific to the MHRSS programme will occur over the coming survey rounds.

Other

Problems encountered during sampling

Winter 2017 surveys

During the Tauranga Harbour winter survey, strong winds necessitated the relocation of several sampling locations to nearby suitable sites, notably crab trap locations along the eastern coastline outside the harbour. Heavy shipping presence at the main port berths during the survey also necessitated relocation of several crab trap and diver search locations.

Shipping channel and berth dredging operations were being undertaken alongside Victoria (T/U) wharf during the Otago Harbour winter survey. Thus, pre-allocated crab trap and diver search locations in this area were relocated to nearby suitable locations.

During the Port Taranaki winter survey, several benthic sled, crab trap and diver search locations pre-allocated to the main port shipping berths had to be relocated to nearby appropriate sites due to vessel occupation.

Strong winds during the Bluff Harbour winter survey reduced the area available for safe setting and retrieval of crab traps, and prevented the crab trapping boat from safely operating for the majority of one day. Where possible, crab traps were relocated to nearby calmer areas, but the limited sheltered areas and part-day non-deployment of the trapping boat reduced the total crab trapping effort achieved from a target of 68 trap lines to an achieved total of 61 trap lines. The field team made up for this reduced crab trap sampling effort with extra benthic sled sampling around Island Harbour and Fishing Boat wharves, and an extra shore search around the Bluff township.

For the Wellington Harbour winter survey, although the marine exclusion zone around the earthquake damaged CentrePort Container Terminal has been lifted for vessel traffic,

discussions with CentrePort and the Harbourmaster indicated that the wharf structure in that area was still 'fragile', so no sampling was completed in this area. Pre-allocated diver search locations within the area were relocated to nearby Queens Wharf.

The presence of several leopard seals in Whāngārei Harbour presented a significant health and safety issue for the NIWA survey dive team, and they were advised by NIWA's National Diving Safety Officer and Diving Control Board (DCB) not to undertake any diving operations within the harbour whilst the leopard seals were present in the harbour. A specific NIWA Standard Operating Procedure (SOP) had been developed during the 2016–17 survey year, and approved for implementation by the NIWA DCB, for deploying divers and field staff (i.e., during shore searches) at sites where leopard seals have been detected; the conditions of the SOP were not met during the Whāngārei Harbour winter survey. MPI was informed at the time as to our inability to undertake the survey diving component and total survey effort maintained by increasing benthic sled and shore search sampling effort. The MHRSS team maintained regular contact with the DOC to discuss their management options for the leopard seal (non-intervention unless there was significant cause to act (e.g., actual harm to a person)), as well as marina operators monitoring the presence of the leopard seal, in the interim until the following summer survey.

Heavy rain created zero underwater visibility conditions in Havelock Marina during the Picton Harbour winter survey. This required the deferment of diving activities until the following week. Retrieval of crab condos from the swollen Kaituna River was also not possible until the following week, when river flow had returned the river to a safe level.

Strong winds during the Lyttelton Harbour winter survey necessitated relocation of some exposed pre-allocated crab trap locations to nearby suitable locations that were more sheltered. Pre-allocated diver search locations in Magazine Bay and along the port breakwalls were also relocated to the more sheltered Purau Bay.

Summer 2017–18 surveys

The continued presence of several leopard seals in Whāngārei Harbour presented a continued significant health and safety issue for the NIWA survey dive team. Based upon recent field team experience, and consultation with other stakeholders such as marina operators and commercial divers, the original NIWA leopard seal SOP was revised and approved for use by the NIWA DCB for MHRSS survey teams. This revised SOP was successfully implemented during the Summer 2017–18 survey in Whāngārei Harbour, where diving operations were completed, albeit with relocation of the Town Basin Marina locations due to the presence of a leopard seal there.

During the Otago Harbour summer survey, a busy cruise ship schedule, construction activities associated with the extension of the Multipurpose Wharf and gale-force winds required the relocation of some benthic sled, crab trap and diver search sites in Port Chalmers to nearby safer locations.

During the Port Taranaki summer survey, several benthic sled, crab trap and diver search sample locations pre-allocated to the main port shipping berths had to be relocated to nearby appropriate sites due to vessel occupation.

Earthquake damage to the CentrePort commercial port area prevented access to the Thorndon Container Wharf area during the Wellington Harbour summer survey; demolition work had commenced on the southern-most section of wharf. Kings Wharf also had restricted access beneath it for the southern two-thirds of the wharf. The survey team were granted access to

the exclusion zone along Aotea Wharf 200 m north of the northern-most container crane. Affected pre-allocated diving and trapping sampling locations were relocated to nearby appropriate areas within the port.

The revised leopard seal SOP was also successfully implemented during the Waitematā Harbour summer survey, allowing full diver search effort to be conducted. However, several diver search sites in Westhaven Marina had to be relocated to nearby appropriate areas due to leopard seal activity.

Three commercial berthing structures in the Port of Lyttelton (Wharves No. 4 and 5, and Gladstone Pier) remain off-limits to all operations (this includes MHRSS programme crab trapping and diver search sampling) following damage incurred during the 2010–11 Christchurch earthquakes. During the summer survey, Gladstone Pier was in the process of being demolished. Dampier Marina (pile moorings) has been removed and is being replaced by a new pontoon marina, Te Ana Marina. Ongoing construction work during the summer survey required affected pre-allocated diving and trapping sampling locations to be relocated to nearby appropriate areas within the port affected, although diving and trapping activities on the outermost pontoon pier (Pier A) were possible.

Difficulties encountered in meeting minimum monitoring requirements

Except for the leopard seal issue preventing diver searches during the Whāngārei Harbour winter survey, any difficulties encountered were successfully managed, allowing us to meet MHRSS programme minimum monitoring requirements (see above comments).

Problems encountered in reporting surveillance results

None.

Management actions taken to reduce problems encountered

Where pre-allocated sampling locations could not be accessed because of, for example, the presence of a vessel alongside the wharf or unsafe weather conditions, the sample was taken (relocated) as close as possible to the pre-allocated location and GPS coordinates recorded.

The working solution to sampling within the marine farming area to the north of Tikore Island in Bluff Harbour is to be maintained with the farm owner's consent and the following modifications to sample design; no trapping or sledging will be conducted in the farm lease area, but diver searches will be allocated there to search the submerged farm structures.

Regarding the leopard seal issue, as mentioned previously the leopard seal SOP will continue to be refined and improved as applicable. This SOP was revised in October 2017 following the abandonment of diving activities during the Whāngārei Harbour summer survey, and approved for implementation during the Summer 2017–18 survey round. Following the Whāngārei Harbour summer survey, further revisions have been made to the leopard seal SOP to improve its utility. NIWA will continue to liaise with DOC and port or marina companies as to the whereabouts of any leopard seals (and any other potentially dangerous megafauna) prior to surveys taking place. The spatial and temporal distribution of leopard seals in New Zealand waters is being investigated for the first time in a new NIWA project based on records from a DOC database and the published literature, with a view to identifying possible causes for transient leopard seals appearing in New Zealand waters. The research will expand NIWA research on Antarctic marine mammals and aligns with a new NIWA strategic research direction that is focused on assessing marine mammal distribution and movements in New Zealand waters. The project will also serve as a pilot study to potentially leverage funding for passive acoustic monitoring of leopard seals around New Zealand by NIWA. An SOP formalising diving activities in the presence of sea lions, a lesser threat compared to

leopard seals, but still a significant hazard to divers and field staff at some southern High Risk Sites, has also been developed and approved for use by the NIWA Diving Control Board (DCB).

Isolated instances of theft or removal of unattended sampling gear does occur. To discourage theft and people inspecting or moving our crab (box) traps and condos, we have tagged all our trapping gear (that is left unattended) with rugged waterproof tags that identify NIWA as the agency responsible for the gear, specify penalties under the Biosecurity Act 1993 for interfering with the sampling gear and the MPI Special Permit number assigned to NIWA under which the MHRSS programme operates.

Management actions taken to address foreseeable problems

The Health and Safety at Work Act 2015 (HSWA) has seen significant changes to Health & Safety policies and practices at some commercial port areas at High Risk Sites. Whilst this has not yet prevented NIWA from conducting MHRSS programme surveys, it has increased stakeholder liaison workload, the need for proof of NIWA safe working practices and requirement for site induction processes. Proactive and timely liaison with pertinent stakeholders (by both NIWA and MPI) regarding the implementation of the MHRSS programme surveys will be an ongoing requirement. Various degrees of work approval and permitting prior to survey activities commencing are required at an increasing number of the High Risk sites for particular areas of commercial activity (i.e., ports and marinas). As this work approval and permitting issue cuts across all commercial New Zealand ports, we are being proactive and all NIWA MHRSS field team leaders (FTLs) are to undertake NZQA-training to be a qualified Permit to Work Receiver (PWR, New Zealand Qualifications Authority Unit Standard 17588) training to ensure continued port access; seven NIWA FTLs have undertaken PWR training to date.

MHRSS programme survey operations entail an inherent biosecurity risk, whereby marine organisms could potentially be spread within, and between High Risk locations associated with our small boats, vehicles and sampling gear. Thus, a biosecurity Standard Operating Procedure (SOP) specific to the MHRSS programme has been developed that details survey 'decontamination' procedures for NIWA small boats, vehicles and sampling gear to manage any associated biosecurity risk associated with survey activities within, and between MHRSS High Risk Sites. This Biosecurity SOP has been provided to all NIWA FTLs and to MPI. The SOP is a 'living' document that is to be revised as required.

MPI has provided NIWA with an exemption under Biosecurity Act 1993, sections 52 and 53, relating to the ability to move or "communicate" notifiable pests. This will legally cover NIWA from prosecution (by MPI) in terms of transporting (preserved or fixed) notifiable pests from High Risk locations to MITS for the purposes of identification.

NIWA FTLs are Authorised Persons under the Biosecurity Act 1993 for survey activities undertaken as part of the MHRSS programme. Although vessels are not target structures for inspection during MHRSS programme surveys, such inspections may occur. Where removal of Suspect Samples is undertaken from private vessels or structures, the removal must be undertaken by, or supervised by an Authorised Person, and undertaken in accordance with the Biosecurity Act 1993. If a Suspect Sample is identified on a private vessel or structure, and the person appearing to be in charge of that vessel or structure objects to the collection of a Suspect Sample, we will inform the MPI Operational Liaison as soon as practical, providing information on the vessel type, name, identifying features, and location. If the MPI Operational Liaison is not available, then we will call the pest and disease hotline as soon as practical, providing information on the vessel type, name, identifying features, and location. If

we take a Suspect Sample from a vessel, and the owner or operator is not present, we must leave an appropriate notification. MPI has provided NIWA with an appropriate inspection notification form for this purpose. Re-authorisation of NIWA FTLs occurred in 2018 to extend their Authorised Person status for a further three years.

Stakeholder engagement, public awareness and media contact

The response from stakeholders contacted prior to the survey to inform them and obtain permission was generally rapid, and aside from restricted access to some site-specific locations at certain times due to port or marina operations and vessel traffic, no overall problems were encountered regarding access to sample locations. Introduction of the Health and Safety at Work Act 2015 (HSWA) has seen port and marina companies increasing their health and safety requirements pertaining to external agencies operating in their jurisdiction. This has resulted in new or upgraded operating area induction processes, varying degree of permitting of survey activities and evidence of appropriate compliance with the HSWA for the MHRSS programme survey field teams.

The identification of known, or potential hazards specific to each High Risk Site is a critical component of our workplace health and safety practice. In addition to our own specific MHRSS programme process of identifying and managing site-specific risks, during the pre-survey stakeholder communications process NIWA FTLs specifically request that the stakeholders identify any known or potential hazards they are aware of that could affect the survey team. Any hazards identified by stakeholders, as well as by the survey team themselves, are to be detailed in the interim post-sampling reports which are sent to MPI and copied to the NIWA FTLs.

To answer any concern from stakeholders about not being aware of the MHRSS programme surveys, MPI have provided NIWA with a one-page summary marine pest survey notification poster for wider pre-survey dissemination. For each survey, this one-page summary marine pest survey notification poster was sent to our main stakeholder contacts (e.g., port and marina operators, harbourmaster, regional councils etc.) for them to disseminate to their own stakeholders as appropriate. Copies of these posters were also placed by the survey field teams at strategic points (e.g., boat ramps, marina or boat club noticeboards etc.) at the start of each survey to inform wider stakeholders and the public as to the survey activity.

The reporting of MHRSS programme survey results to stakeholders was conducted via MPI stakeholder notices following the completion (and identification of any samples collected) of each survey. For the Summer 2017–18 round of surveys, extra detection information for target and non-target NIS was provided to MPI in the NIWA interim post-sampling reports for each survey to facilitate rapid dissemination of detection details by MPI to stakeholders.

During MHRSS programme surveys, individuals representing various stakeholders with vested interest in survey locations, biosecurity and education activities sometimes accompanied the field teams to observe, and sometimes participate in sampling activities (see Table 7).

Table 7: Stakeholders observing/participating in the Winter 2017 and Summer 2017–18 Marine High Risk Site Surveillance (MHRSS) programme surveys.

High Risk Site	Winter 2017 survey	Summer 2017–18 survey
Bluff Harbour	Environment Southland	
Lyttelton Harbour/Whakaraupō		
Nelson Harbour		
Ōpua Marina/Waikare Inlet	Northland Regional Council (Biosecurity)	Northland Regional Council (Biosecurity)
Otago Harbour		
Picton Harbour		
Port Taranaki		Port Taranaki
Tauranga Harbour		
Waitematā Harbour		New Zealand Geographic
Wellington Harbour	Ministry for Primary Industries	
Whāngārei Harbour	Northland Regional Council (Biosecurity)	Northland Regional Council (Biosecurity)

During the Waitematā Harbour Summer 2017–18 survey, a New Zealand Geographic film advisor joined the survey team as part of their Hauraki Gulf 360 project. This project aims to bring the wonder and complexity of the Hauraki Gulf to New Zealanders using the immersive new medium of virtual reality. Invasive species are just one of many issues affecting the Hauraki Gulf ecosystem. Using the Boxfish 360 underwater camera, NIWA divers captured 360° video of MHRSS survey activities in the Viaduct Harbour during the MHRSS Summer 2017–18 survey to illustrate targeted surveillance for NIS such as *Sabella spallanzanii*. This videography was pre-approved by MPI as per our agreed communications strategy.

Casual enquiries from members of the public, port and marina operators, owners or staff were responded to by the field team leader as per the short-term communications policy between MPI and NIWA.

In collaboration with MPI, NIWA's MITS ran three workshops for stakeholder on marine pest identification and sample preservation and transport (Invercargill - December 2017, Nelson - February 2018 and Tauranga - June 2018), which provided a valuable opportunity to interact with stakeholders and additionally inform them as to MHRSS programme activities and findings.

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Appendix 1. Summary of sampling methods, target species and habitats in the Marine High Risk Site Surveillance (MHRSS) programme

Note: underlined species have been collected using this method during the present or previous target-species surveillance programmes in New Zealand.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Benthic sled ¹⁴	<u><i>Arcuatula senhousia</i></u> <i>Asterias amurensis</i> <u><i>Caulerpa taxifolia</i></u> <u><i>Carcinus maenas</i></u> <u><i>Eudistoma elongatum</i></u> <i>Potamocorbula amurensis</i> <u><i>Sabella spallanzanii</i></u> <u><i>Styela clava</i></u>	<u><i>Acentrogobius pflaumi</i></u> <u><i>Chaetopterus</i> sp.</u> <u><i>Charybdis</i> (<i>Charybdis</i>) <i>japonica</i></u> <u><i>Didemnum vexillum</i></u> <i>Grateloupia turuturu</i> <u><i>Metapenaeus bennettiae</i></u> <u><i>Pyromaia tuberculata</i></u> <u><i>Theora lubrica</i></u> <u><i>Undaria pinnatifida</i></u>	Subtidal soft sediments. Particular focus on known shellfish beds (for <i>Asterias</i>) and areas next to public access (e.g., wharves, boat ramps, marinas, etc. <i>Caulerpa</i> , <i>Sabella</i>).	Narrow width but 100-m tow length and high replication (100+ per location) enables a reasonably large area to be sampled (ca 3500 m ² per location).	Reliable sample collection including asteroids, infaunal and epifaunal bivalves and polychaetes and macroalgae, as well as some crab and fish species.	Processing of sled contents can be time consuming.	Feasible on all soft-sediment habitats under reasonable weather conditions. Can be limited by the presence of large amounts of benthic macroalgae, rocky substratum or soft mud that block the mouth of sled.	Yes	Yes

¹⁴ Similar in design to an Ockelmann (1964) detritus-sledge.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Crab (box) traps	<i>Asterias amurensis</i> <i>Carcinus maenas</i> <i>Eriocheir sinensis</i> <i>Styela clava</i> ¹⁵	<i>Acentrogobius pflaumii</i> <i>Charybdis</i> (<i>Charybdis</i>) <i>japonica</i> <i>Pyromaia tuberculata</i>	Adjacent to wharf pilings and other artificial habitats. Intertidal and shallow subtidal rocky shores, breakwalls and saltmarsh. Particular focus on habitats with complex physical structure (e.g., mussel beds, seagrass beds)	Sampled area is dependent on dispersion of bait odour. High replication possible.	Effectively samples other species of crabs (e.g., <i>Hemiplax hirtipes</i> , <i>Notomithrax</i> spp., <i>Ovalipes catharus</i> , <i>Metacarcinus novaezealandiae</i>) and echinoderms (e.g., <i>Patiriella regularis</i> , <i>Coscinasterias muricata</i>). Also samples a wide range of fish species. Biofouling species may also be incidentally captured with this method if attached to mobile organisms attracted to the traps (e.g., <i>Styela clava</i> attached to masking crabs)	Quick to deploy and recover, so high replication possible.	Most locations and weather conditions.	Yes	Yes (Hewitt and Martin 2001; May and Brown 2001; Thresher et al 2003; Yamada et al 2005)

¹⁵ Incidentally, as specimens attached to masking crabs (*Notomithrax* spp.) caught in traps.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Crab condos	<i>Carcinus maenas</i> <i>Eriocheir sinensis</i>	<i>Acentrogobius pflaumii</i> <i>Charybdis</i> (<i>Charybdis</i>) <i>japonica</i> <i>Metapenaeus bennettiae</i> <i>Pyromaia tuberculata</i> <i>Tritia burchardi</i>	Intertidal and shallow subtidal banks of rivers. Particular focus on brackish water habitats with complex physical structure (e.g., saltmarsh or fringing vegetation).	High replication possible. Availability of suitable estuarine habitat may limit deployment.	Effectively samples other species of crabs (e.g., <i>Austrohelice crassa</i> , <i>Hemigrapsus crenulatus</i> , <i>Hemiplax hirtipes</i>). Higher rates of detection of crabs than baited traps in muddy river banks (Veldhuizen, 2000).	Quick to deploy and recover, so high replication possible.	High – access problems at some locations (shallow water, deep mud, private land).	Yes	Yes (Veldhuizen 2000)

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Diver searches	<i>Arcuatula senhousia</i> <i>Asterias amurensis</i> <i>Carcinus maenas</i> <i>Eriocheir sinensis</i> <i>Eudistoma elongatum</i> <i>Sabella spallanzanii</i> <i>Styela clava</i>	<i>Amathia verticillata</i> <i>Caprella mutica</i> <i>Chaetopterus</i> sp. <i>Charybdis (Charybdis) japonica</i> <i>Clavelina lepadiformis</i> <i>Didemnum</i> sp. <i>Grateloupia turuturu</i> <i>Hypnea</i> sp. <i>Pyromaia tuberculata</i> <i>Undaria pinnatifida</i>	Wharf piles and berth walls, marina piles and pontoons and other artificial structures, breakwalls and riprap, intertidal and shallow subtidal reefs.	Good – large numbers of piles or lengths of hard substratum can be searched in detail.	Dependent on water clarity and level of biofouling.	Cost-effective in reasonable water clarity, can be time-consuming under poor conditions.	Feasibility dependent on water currents, weather, water clarity and safety issues for divers.	Yes	Yes

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness	Cost effectiveness	Feasibility	Previous targeted surveillance in NZ?	Previous targeted surveillance overseas?
Shoreline searches	<u><i>Arcuatula senhousia</i></u> <i>Asterias amurensis</i> <i>Carcinus maenas</i> <i>Eriocheir sinensis</i> <u><i>Eudistoma elongatum</i></u> <u><i>Sabella spallanzanii</i></u> <u><i>Styela clava</i></u>	<u><i>Amathia verticillata</i></u> <u><i>Chaetopterus</i> sp.</u> <u><i>Charybdis</i> (<i>Charybdis</i>) <i>japonica</i></u> <u><i>Clavelina lepadiformis</i></u> <u><i>Didemnum</i> sp.</u> <u><i>Grateloupia turuturu</i></u> <u><i>Hypnea</i> sp.</u> <u><i>Undaria pinnatifida</i></u>	<p>Sloping sandy shorelines, intertidal rocky reefs and areas where drift material is likely to accumulate.</p> <p>Prevailing winds on preceding days are a useful guide to where material may accumulate.</p>	Wide – can cover long stretches of intertidal habitat quickly.	Used effectively in delimitation studies of <i>Styela</i> .	High	High – access to intertidal areas may be limiting.	Yes	Yes

Appendix 2. Summaries of target versus achieved number of sampling locations for Winter 2017 and Summer 2017–18 Marine High Risk Site Surveillance (MHRSS) programme surveys

BLUFF HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	68	61*	89.7
Benthic sled tows	84	91	108.8
Diver searches	40	40	100.0
Shore searches	25	26	104.0
Sample total	225	226	100.4
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	68	68	100.0
Benthic sled tows	84	84	100.0
Diver searches	40	40	100.0
Shore searches	25	26	104.0
Sample total	225	226	100.4

*Seven crab trap lines not able to be deployed due to unfavourable weather conditions

LYTTELTON HARBOUR/WHAKARAUPŌ

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	31	103.3
Shore searches	25	25	100.0
Sample total	243	245	100.8
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	83	103.8
Benthic sled tows	100	100	100.0
Diver searches	30	31	103.3
Shore searches	25	25	100.0
Sample total	243	247	101.6

NELSON HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	243	100.0
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	102	102.0
Diver searches	30	30	100.0
Shore searches	25	32	128.0
Sample total	243	252	103.7

ŌPUA MARINA/WAIKARE INLET

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	105	105	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	248	248	100.0
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	105	105	100.0
Diver searches	30	30	100.0
Shore searches	25	27	108.0
Sample total	248	250	100.8

OTAGO HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	31	103.3
Shore searches	25	25	100.0
Sample total	243	244	100.4
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	31	103.3
Shore searches	25	25	100.0
Sample total	243	244	100.4

PICTON HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	102	102.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	245	100.8
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	27	108.0
Sample total	243	245	100.8

PORT TARANAKI

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100
Crab (box) trap lines	80	79*	98.8
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	242	99.6
SUMMER 2017–18			
Crab condo lines	8	7**	87.5
Crab (box) trap lines	80	79*	98.8
Benthic sled tows	100	102	102.0
Diver searches	30	30	100.0
Shore searches	25	26	104.0
Sample total	243	244	100.4

*One crab trap line missing

**One condo line stolen

TAURANGA HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	79*	98.8
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	26	104.0
Sample total	243	243	100.0
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	79*	98.8
Benthic sled tows	100	100	100.0
Diver searches	30	31	103.3
Shore searches	25	27	108.0
Sample total	243	245	100.8

* One crab trap line missing

WAITEMATĀ HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	16	16	100.0
Crab (box) trap lines	160	160	100.0
Benthic sled tows	200	201	100.5
Diver searches	60	59*	98.3
Shore searches	50	53	106.0
Sample total	486	489	100.6
SUMMER 2017–18			
Crab condo lines	16	16	100.0
Crab (box) trap lines	160	160	100.0
Benthic sled tows	200	199*	99.5
Diver searches	60	60	101.7
Shore searches	50	53	108.0
Sample total	486	488	100.4

*Field count error.

WELLINGTON HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	244	100.4
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	100	100.0
Diver searches	30	30	100.0
Shore searches	25	25	100.0
Sample total	243	243	100.0

WHĀNGĀREI HARBOUR

Sampling method	Target number of sampling locations	Achieved number of sampling locations	% of target achieved
WINTER 2017			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	126	126.0
Diver searches	30	0*	0.0
Shore searches	25	32	128.0
Sample total	243	246	101.2
SUMMER 2017–18			
Crab condo lines	8	8	100.0
Crab (box) trap lines	80	80	100.0
Benthic sled tows	100	101	101.0
Diver searches	30	30	100.0
Shore searches	25	25	108.0
Sample total	243	244	100.4

*Diver searches unable to be conducted due to the presence of several leopard seals.

Appendix 3. Maps showing locations sampled in Winter 2017 and Summer 2017–18 Marine High Risk Site Surveillance (MHRSS) programme surveys

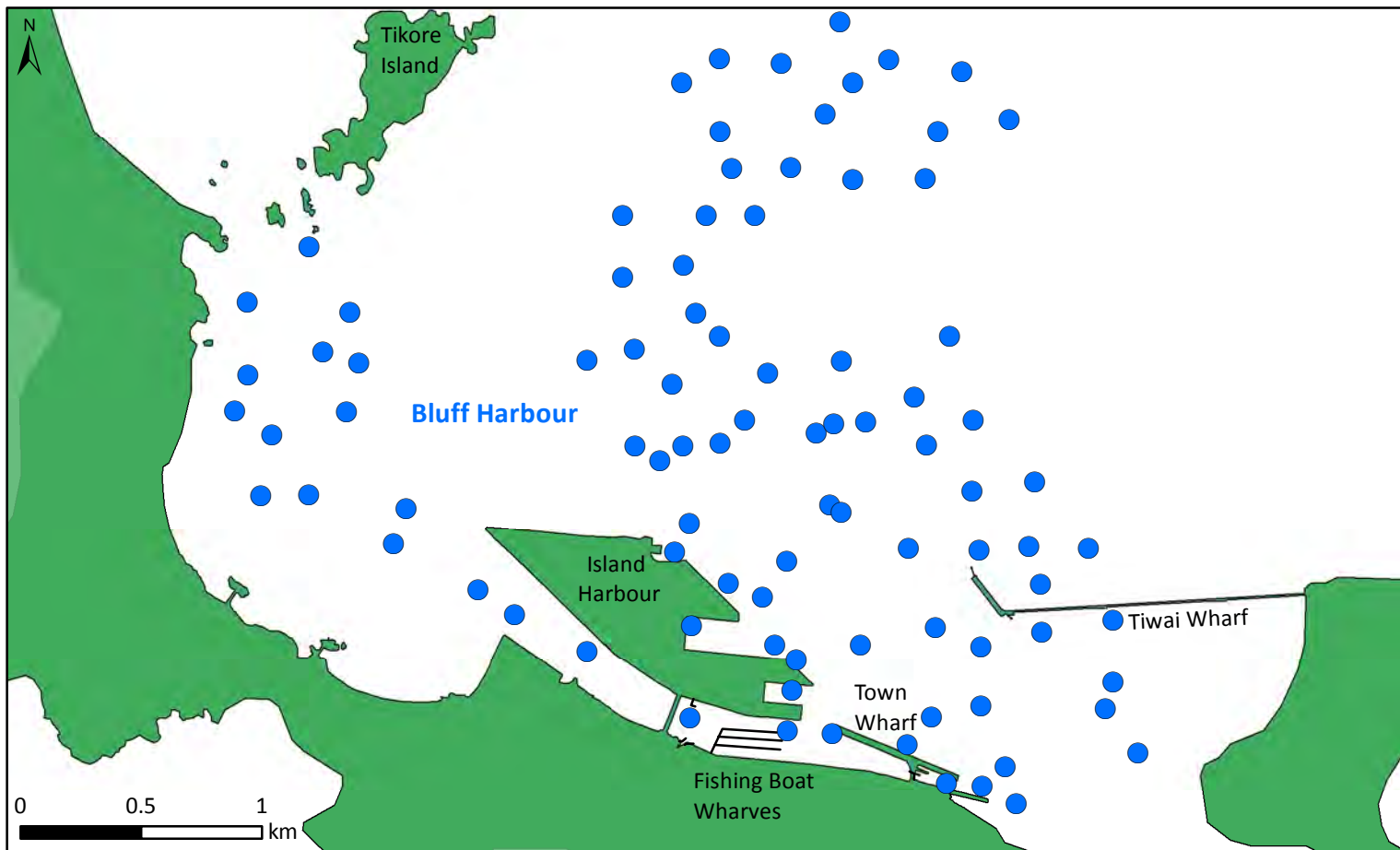
Note: numbers of locations plotted may appear smaller than those shown in Appendix 2 due to points plotting on top of each other as a result of the spatial resolution of the maps.

Note: there are no diver survey locations mapped for the Whāngārei Harbour Winter 2017 survey as no diving was conducted due to safety concerns associated with leopard seal activity in the harbour.

Bluff Harbour

Winter 2017

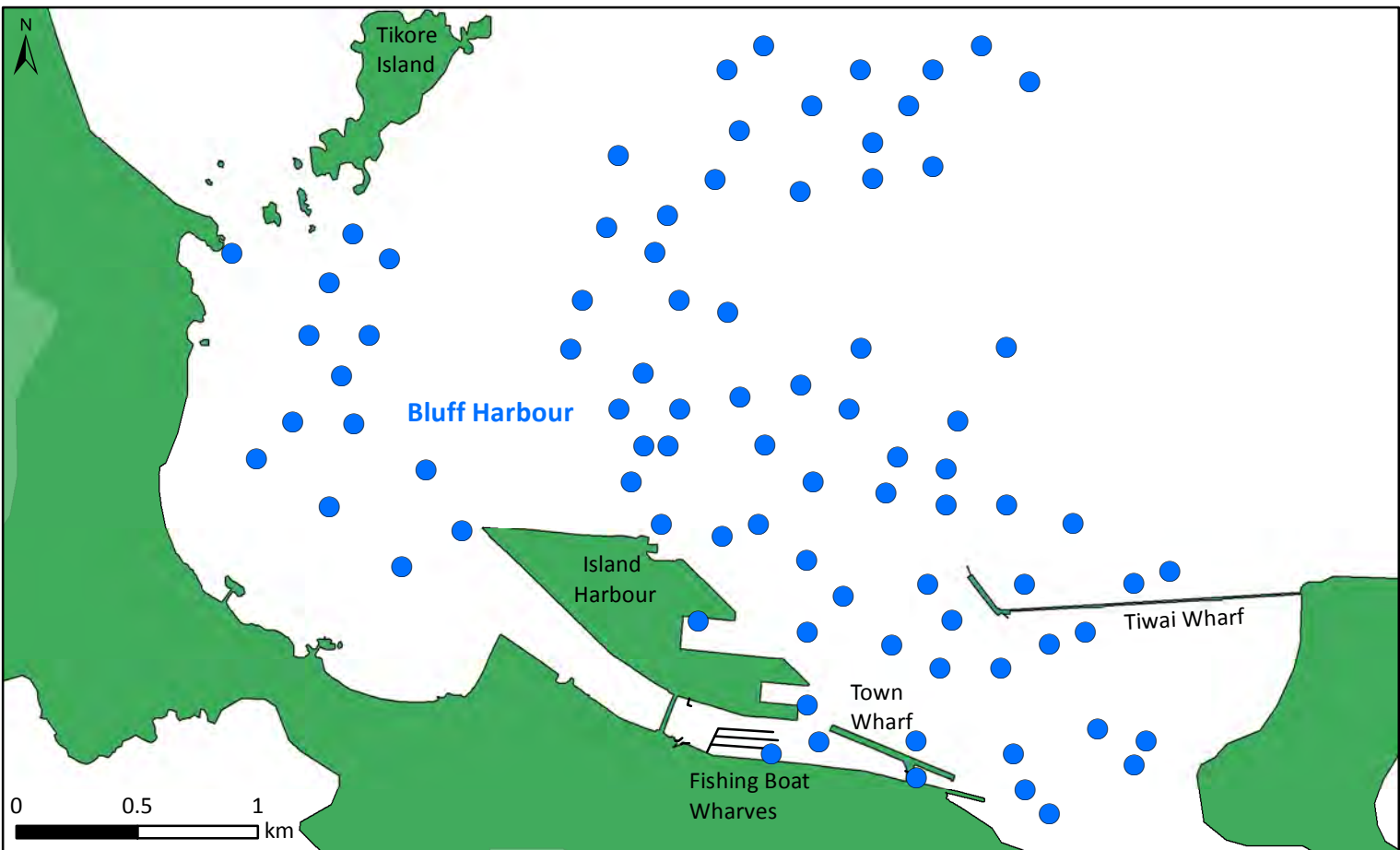
Benthic sled (BSLD) locations



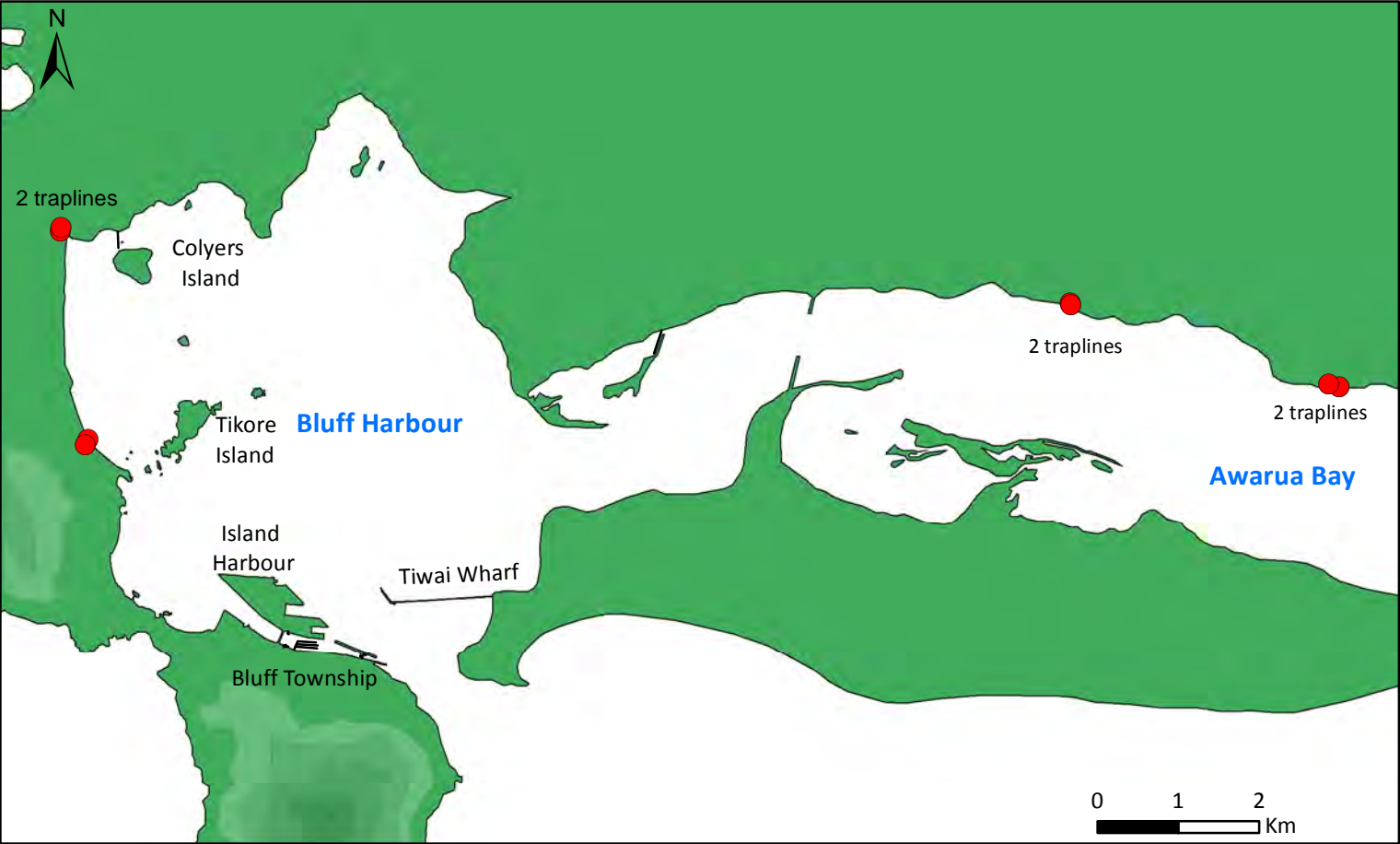
Bluff Harbour

Summer 2017-18

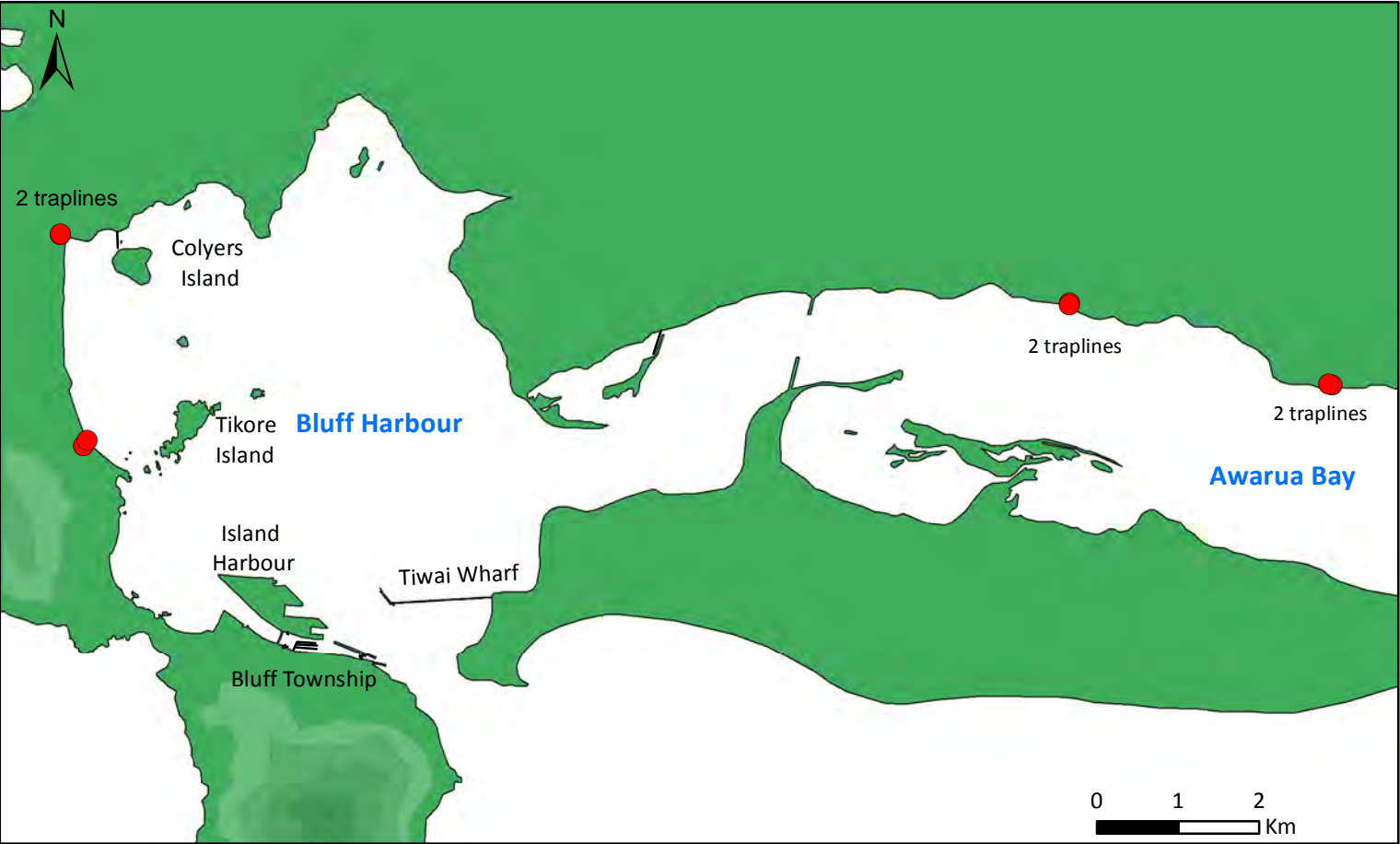
Benthic sled (BSLD) locations



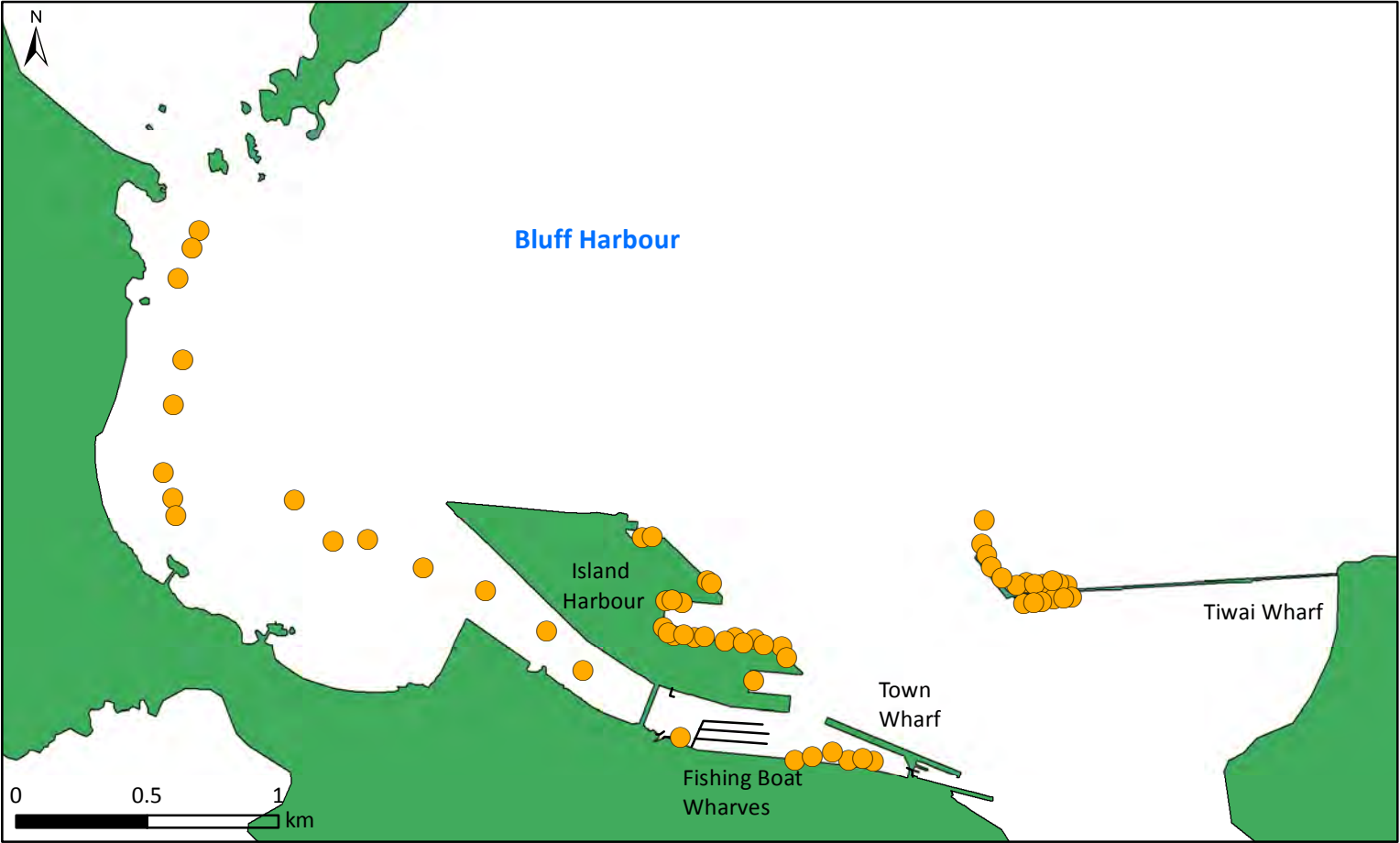
Bluff Harbour
Winter 2017
Crab condo (CONDO) locations



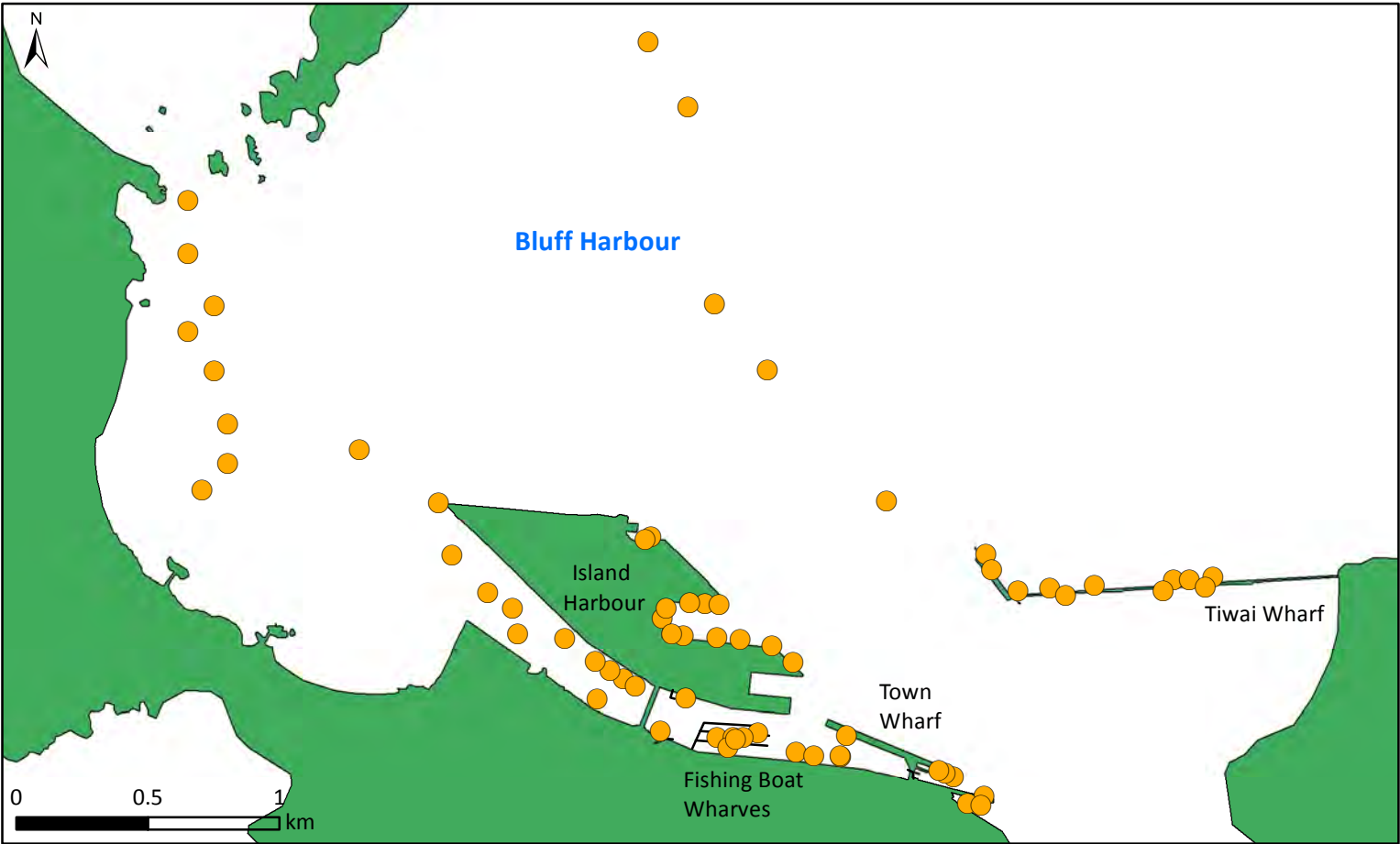
Bluff Harbour
Summer 2017-18
Crab condo (CONDO) locations



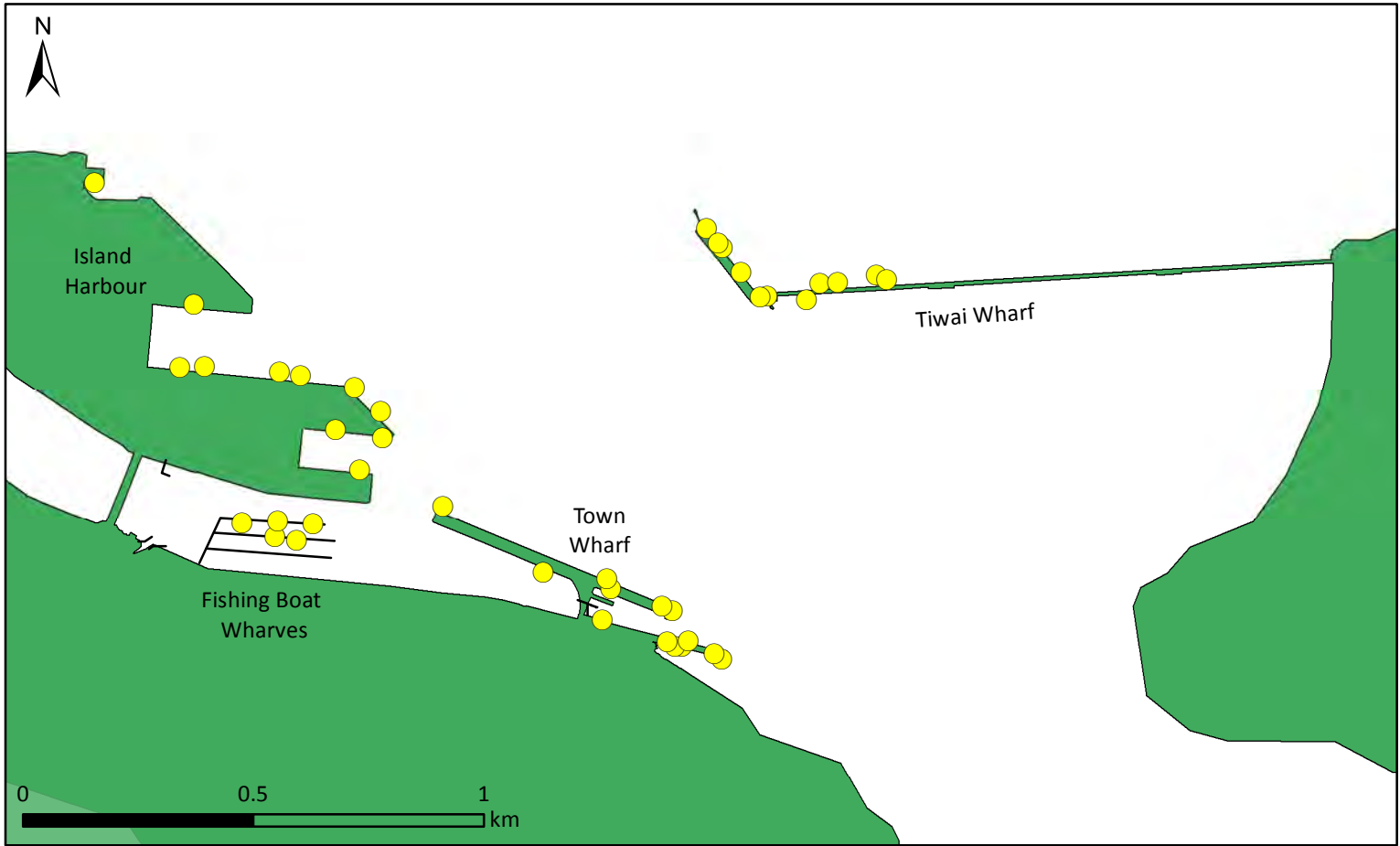
Bluff Harbour
Winter 2017
Crab trap (CRBTP) locations



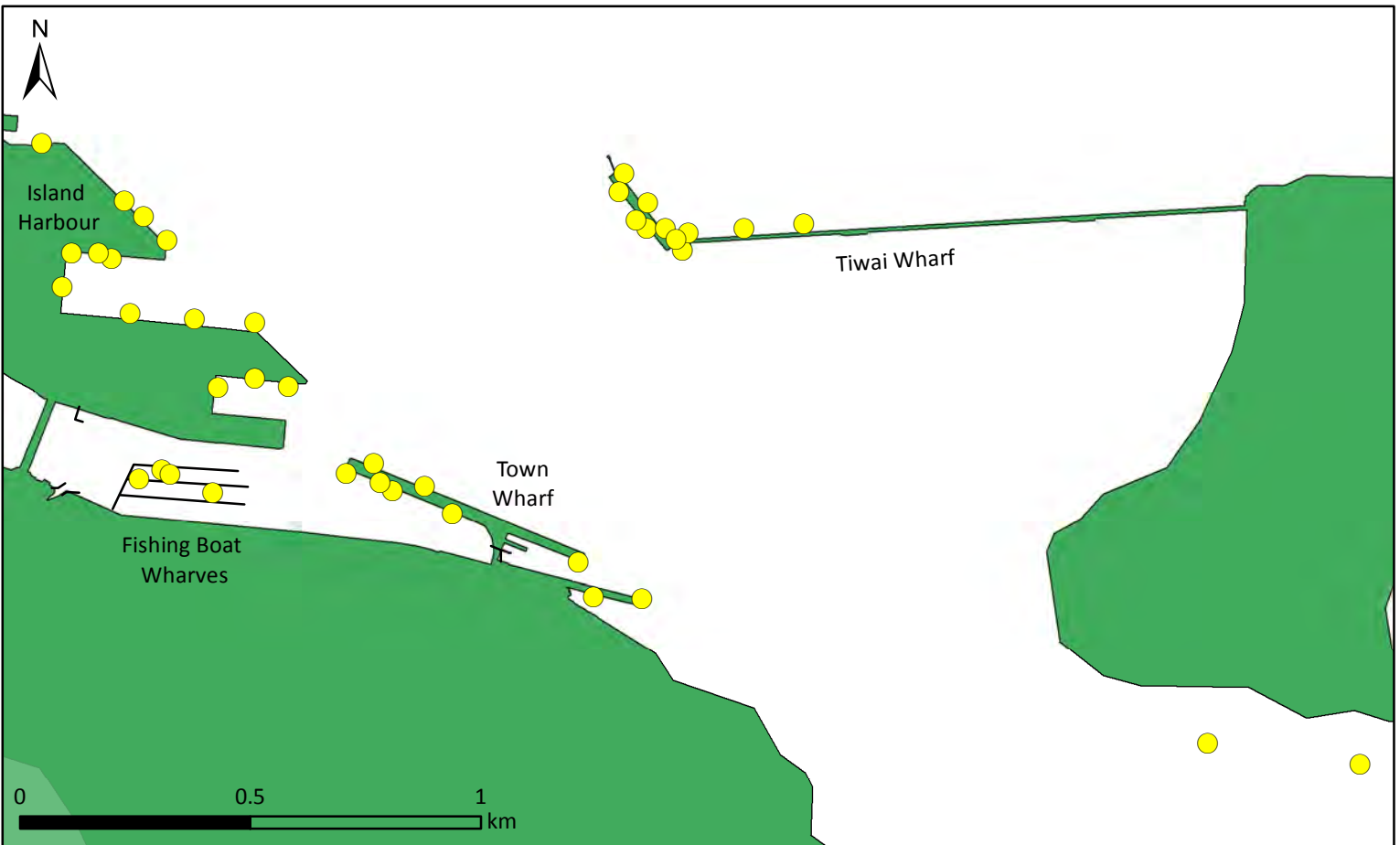
Bluff Harbour
Summer 2017-18
Crab trap (CRBTP) locations



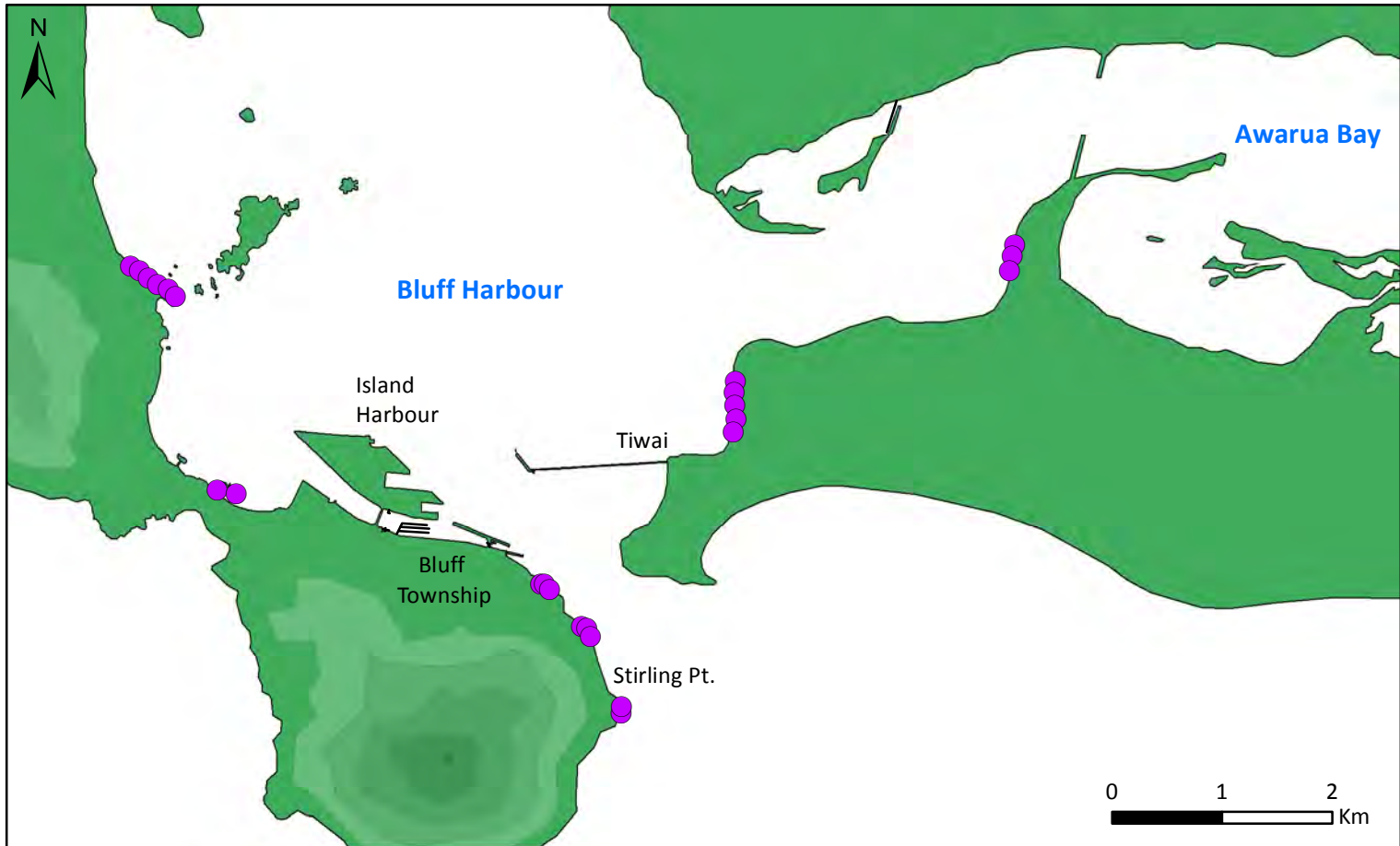
Bluff Harbour
Winter 2017
Diver search (VISD) locations



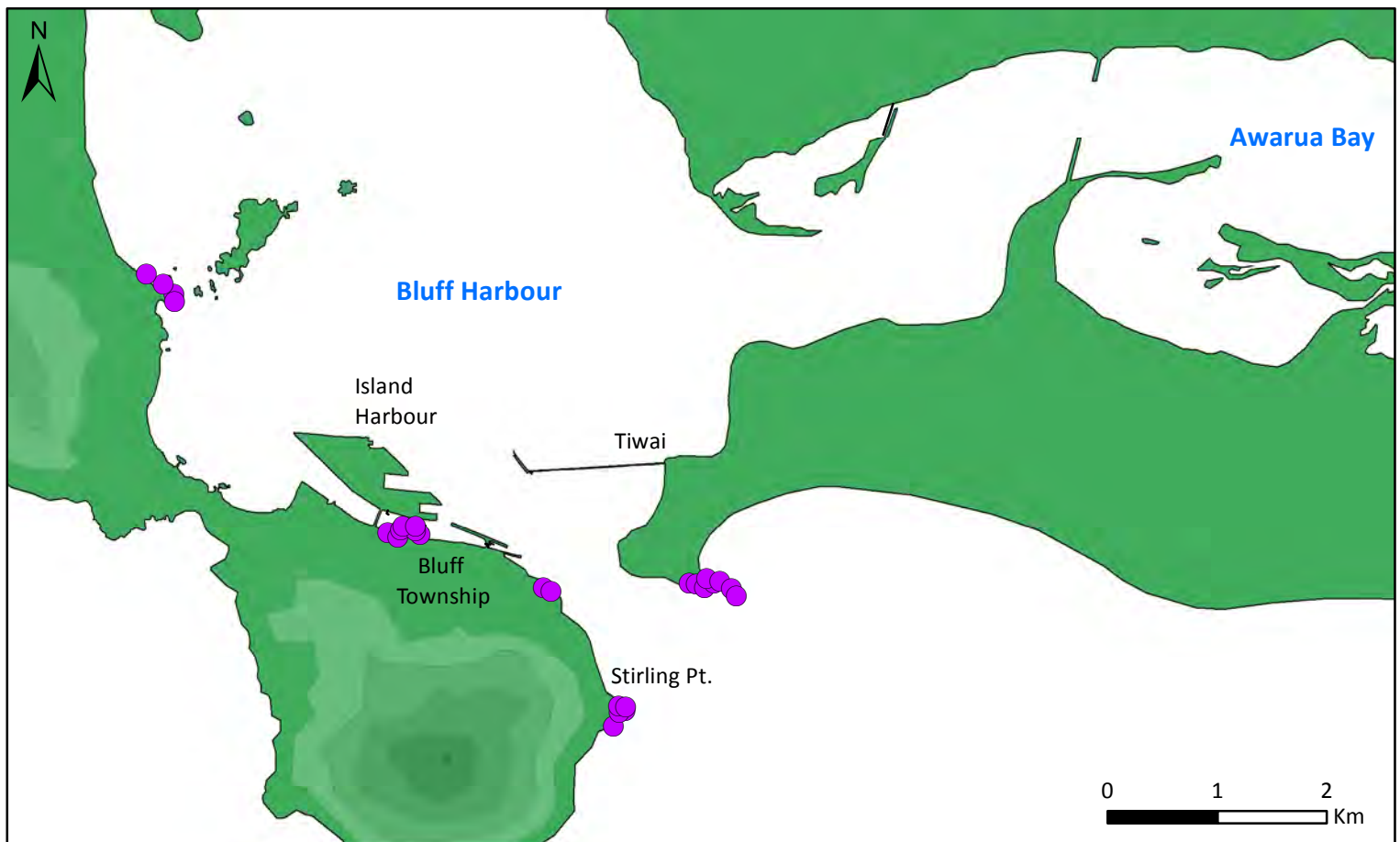
Bluff Harbour
Summer 2017-18
Diver search (VISD) locations



Bluff Harbour
Winter 2017
Shore search (WRACK) locations



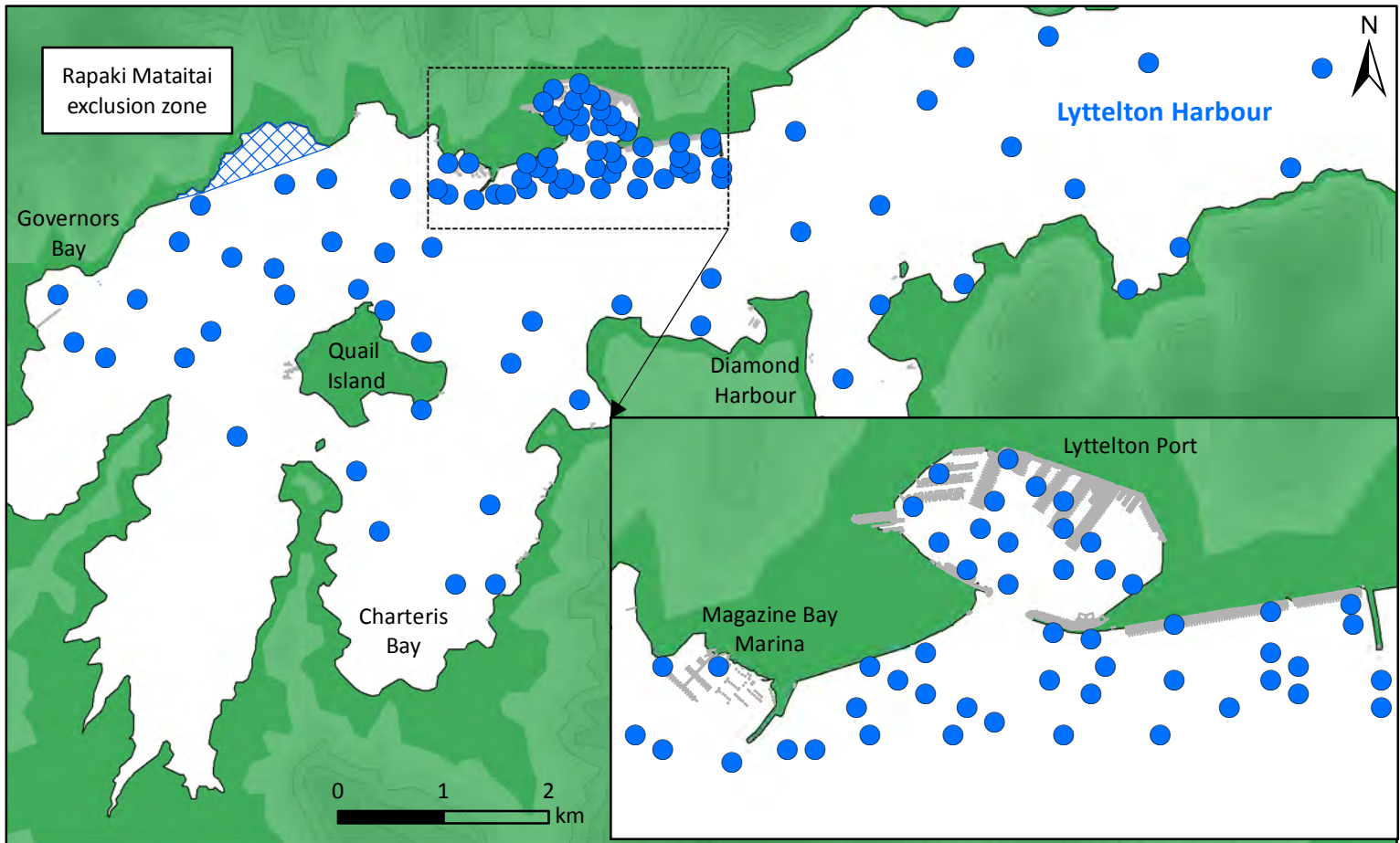
Bluff Harbour
Summer 2017-18
Shore search (WRACK) locations



Lyttelton Harbour/ Whakaraupō

Winter 2017

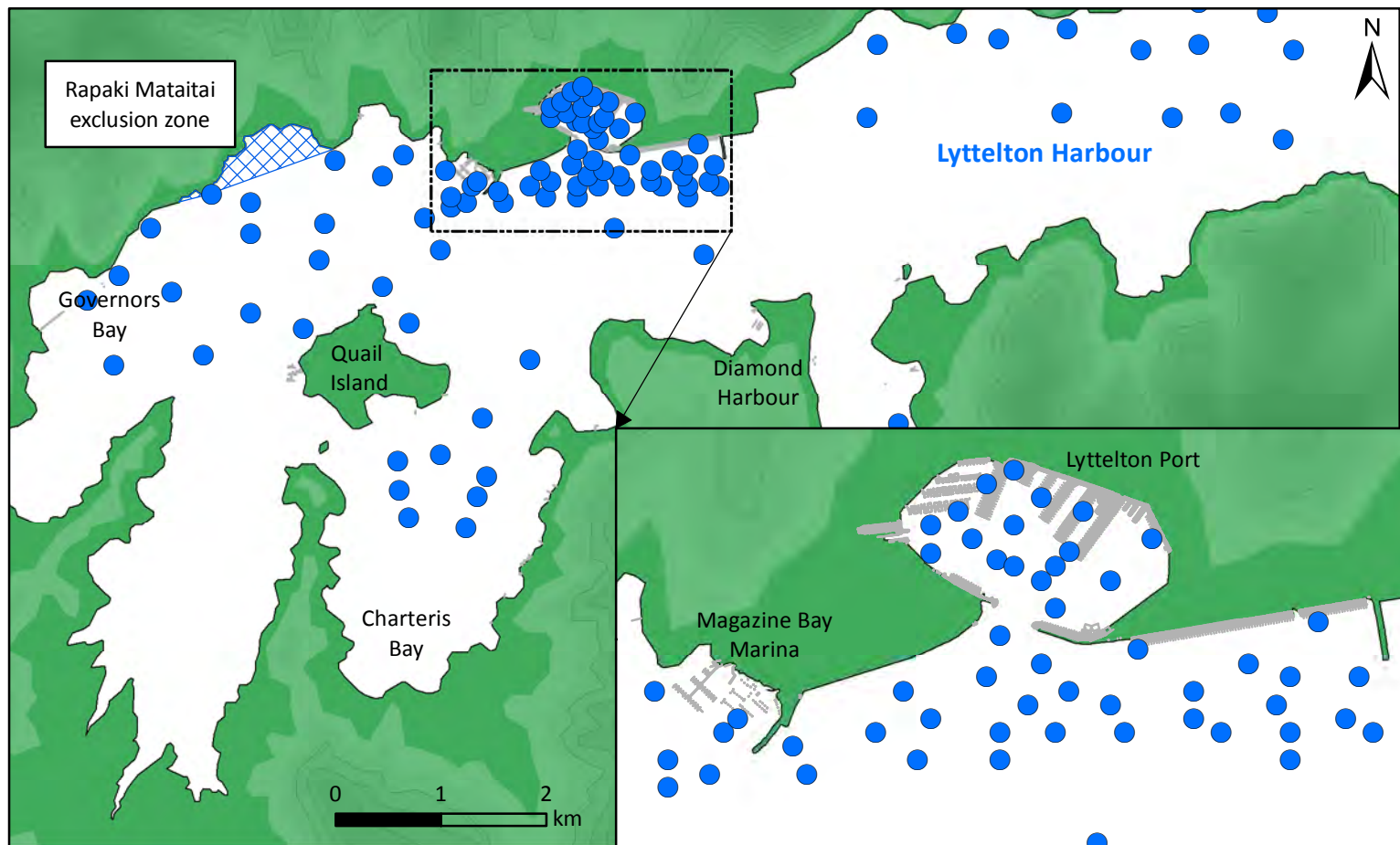
Benthic sled (BSLD) locations



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

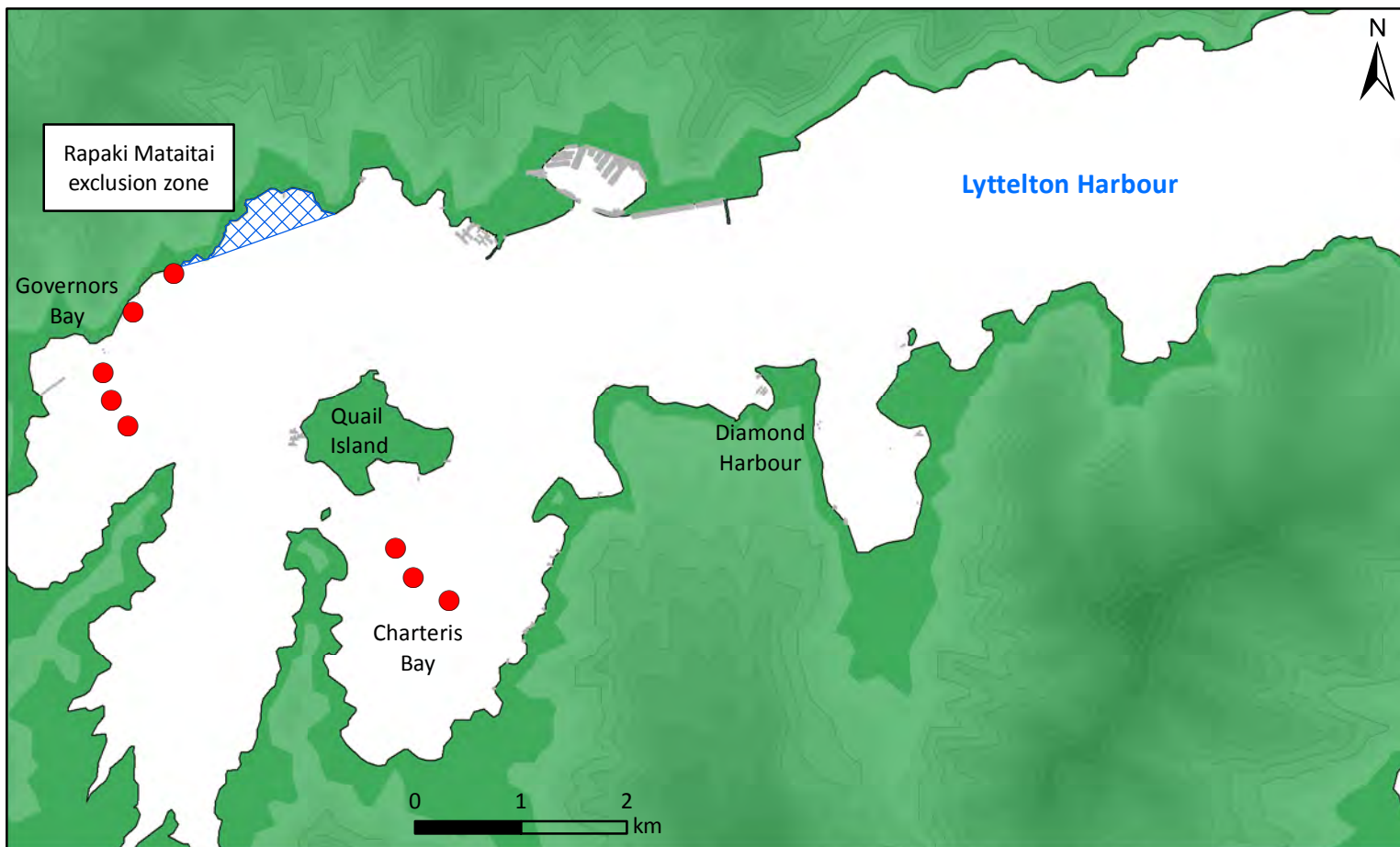
Benthic sled (BSLD) locations



Lyttelton Harbour/ Whakaraupō

Winter 2017

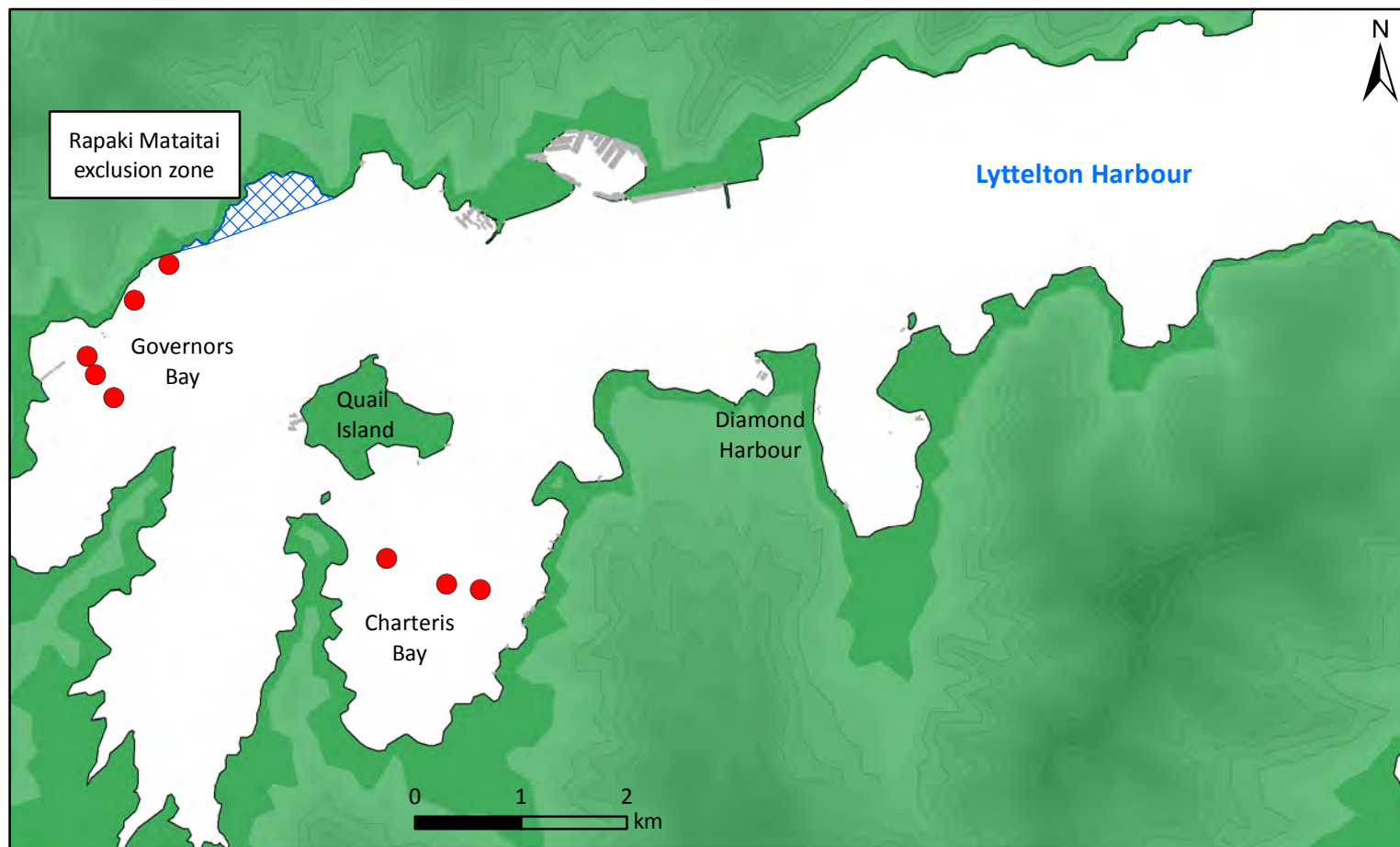
Crab condo (CONDO) locations



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

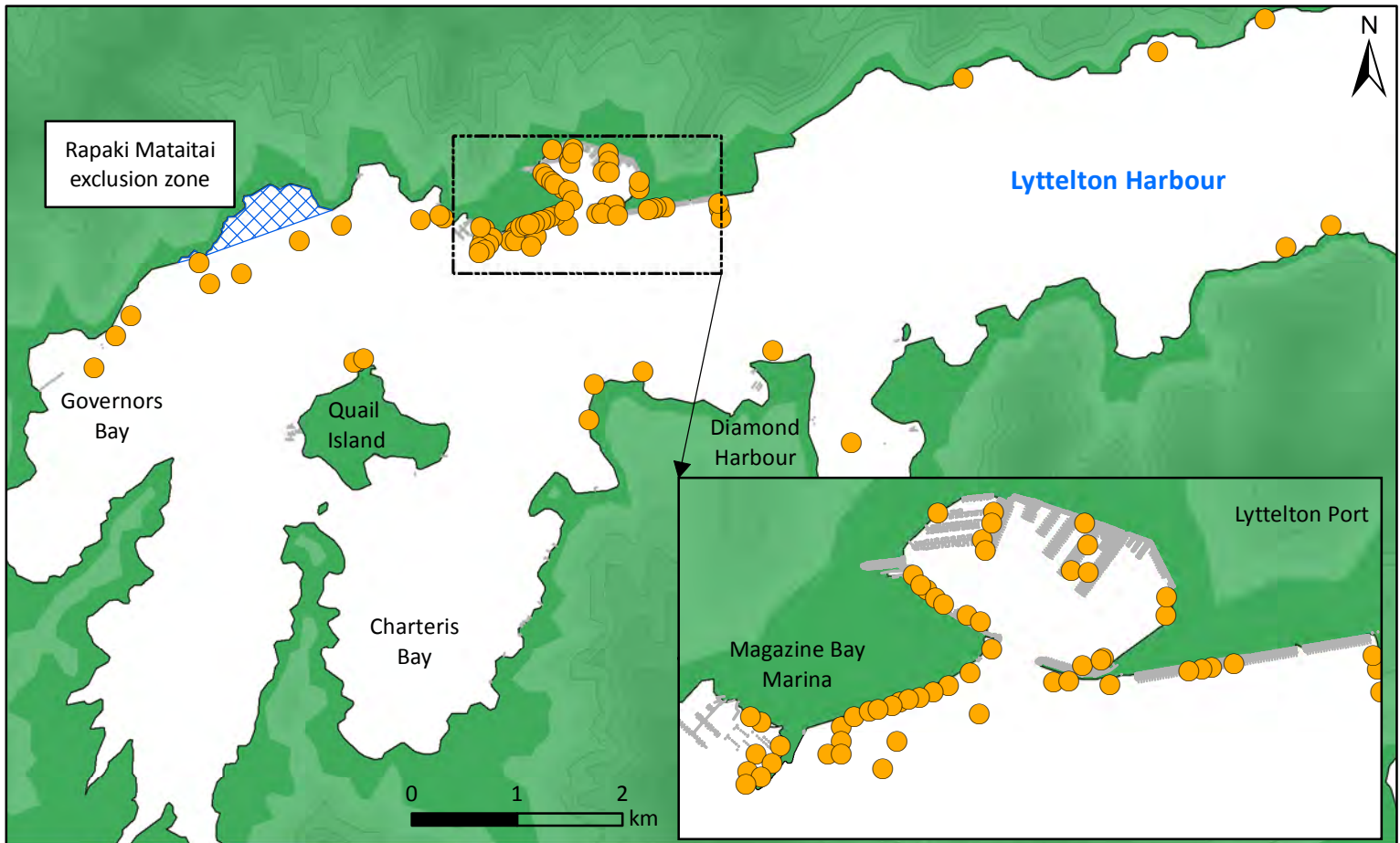
Crab condo (CONDO) locations



Lyttelton Harbour/ Whakaraupō

Winter 2017

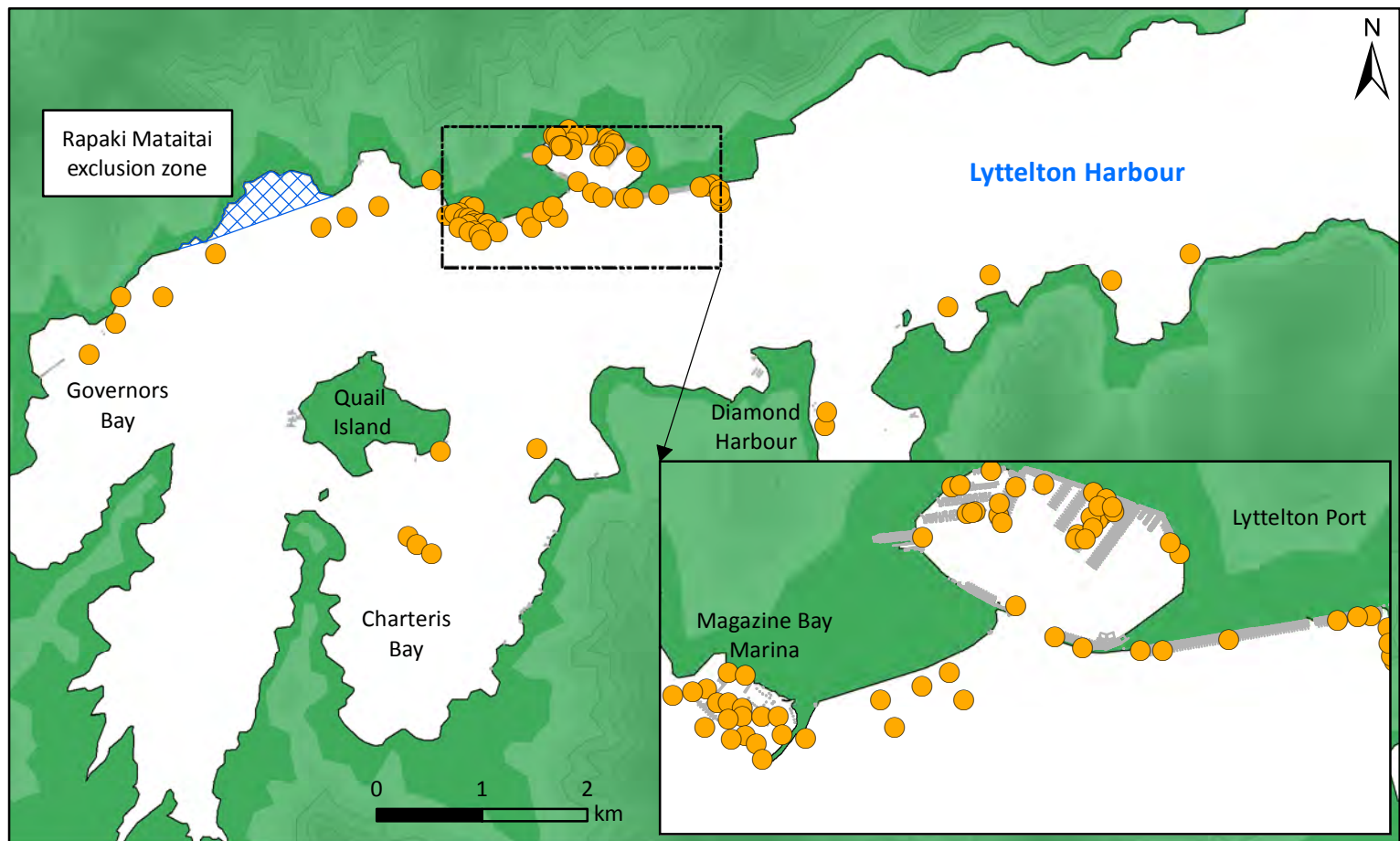
Crab trap (CRBTP) locations



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

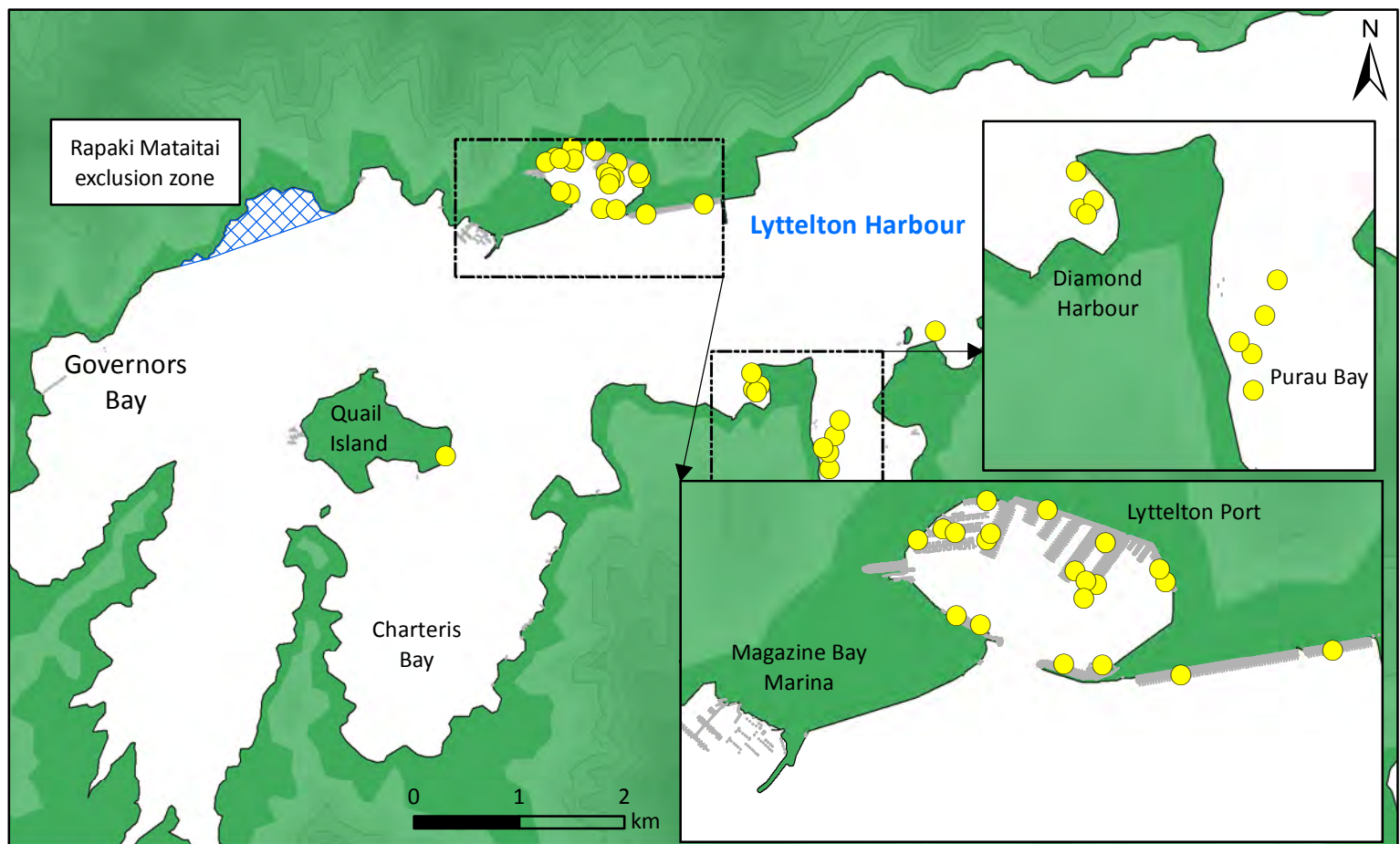
Crab trap (CRBTP) locations



Lyttelton Harbour/ Whakaraupō

Winter 2017

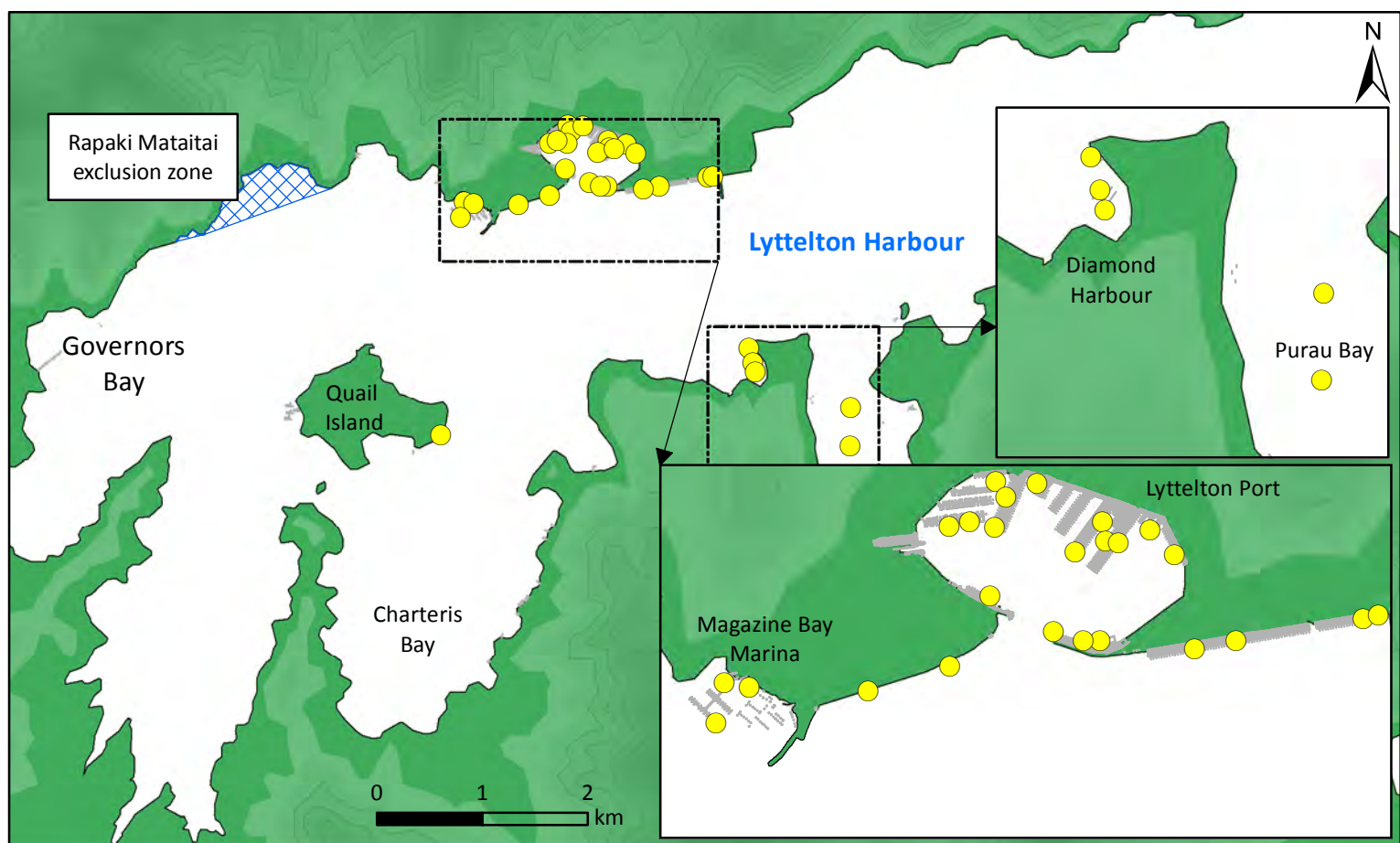
Diver search (VISD) locations



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

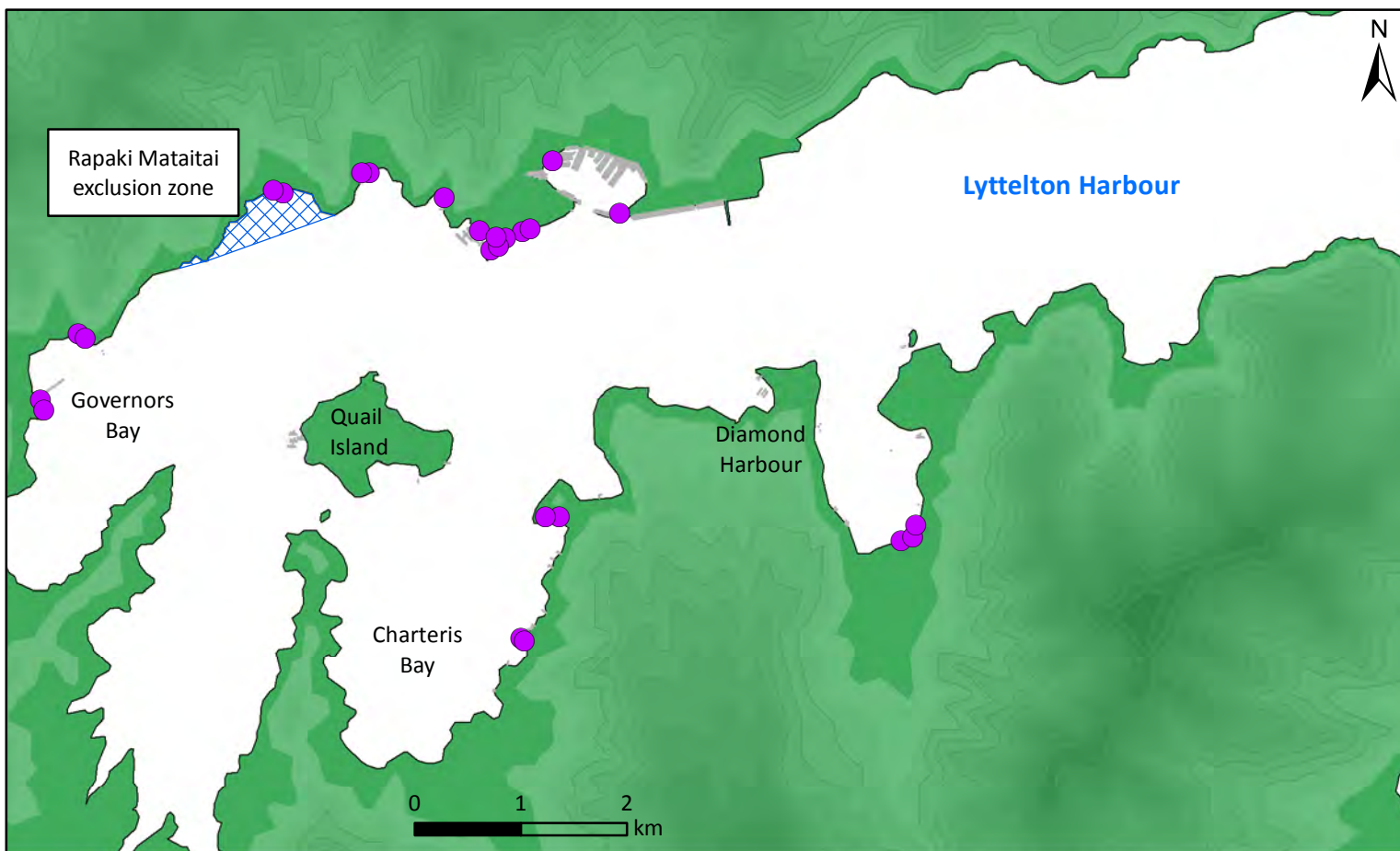
Diver search (VISD) locations



Lyttelton Harbour/ Whakaraupō

Winter 2017

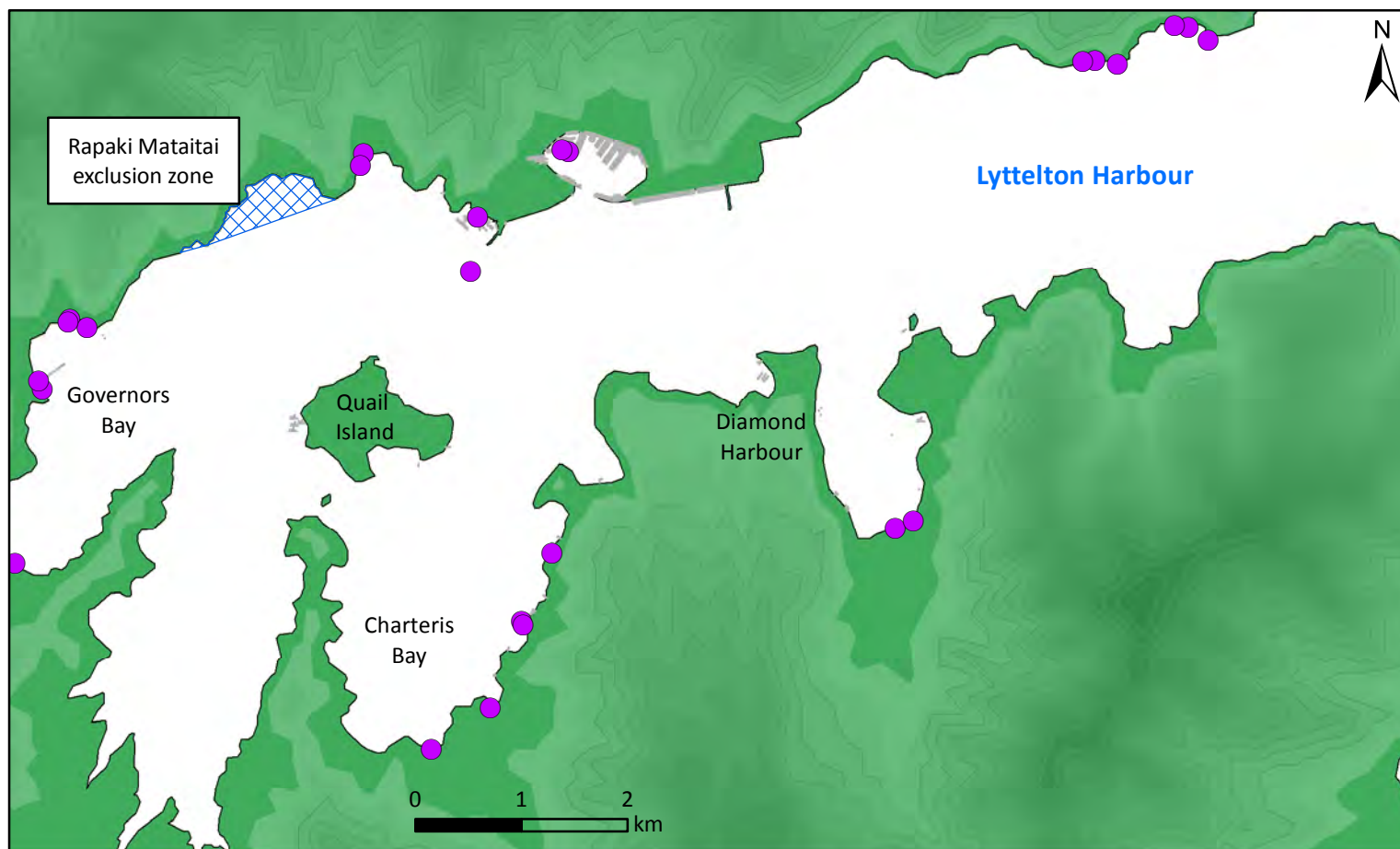
Shore search (WRACK) locations



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

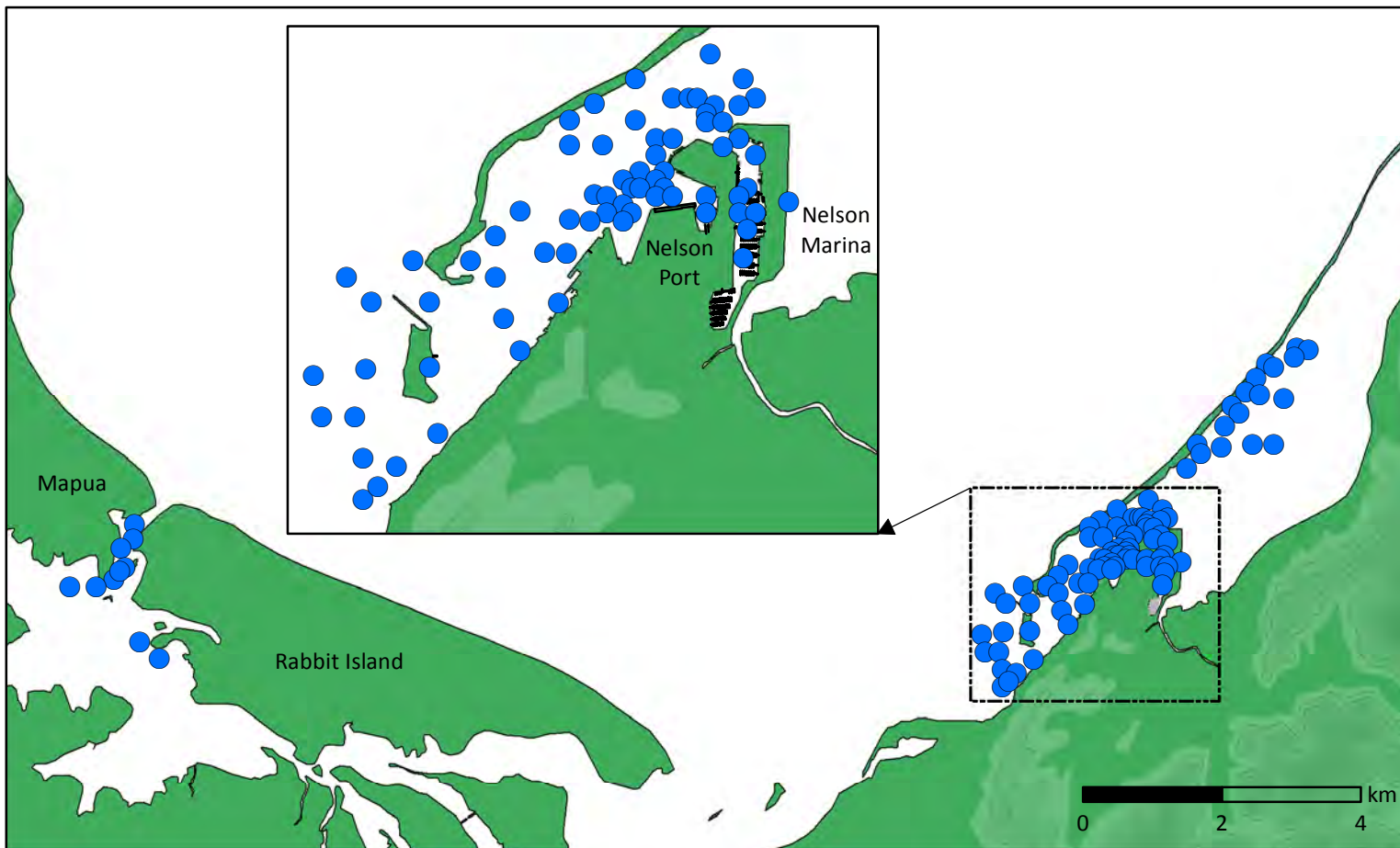
Shore search (WRACK) locations



Nelson Harbour and Waimea Inlet

Winter 2017

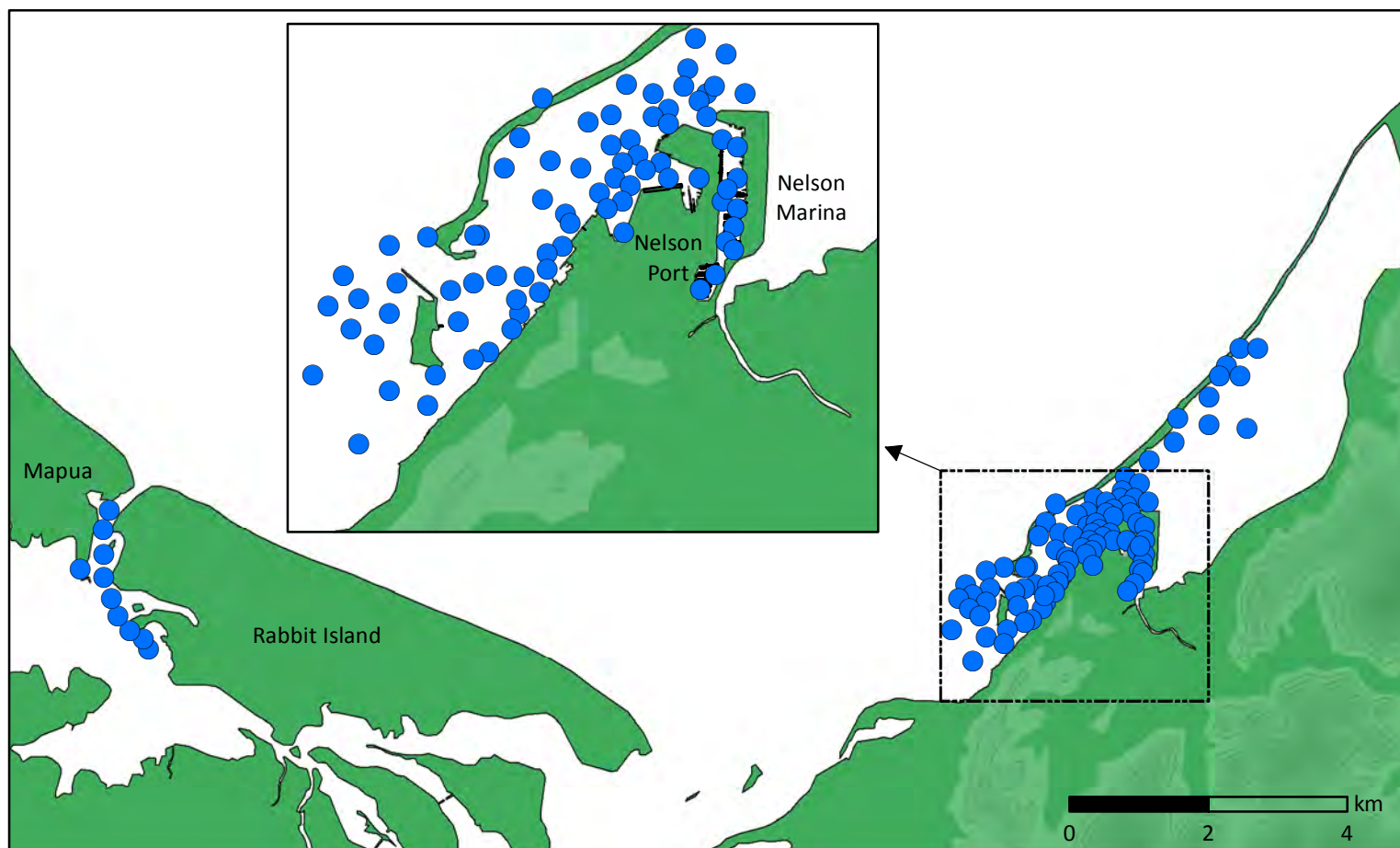
Benthic sled (BSLD) locations



Nelson Harbour and Waimea Inlet

Summer 2017-18

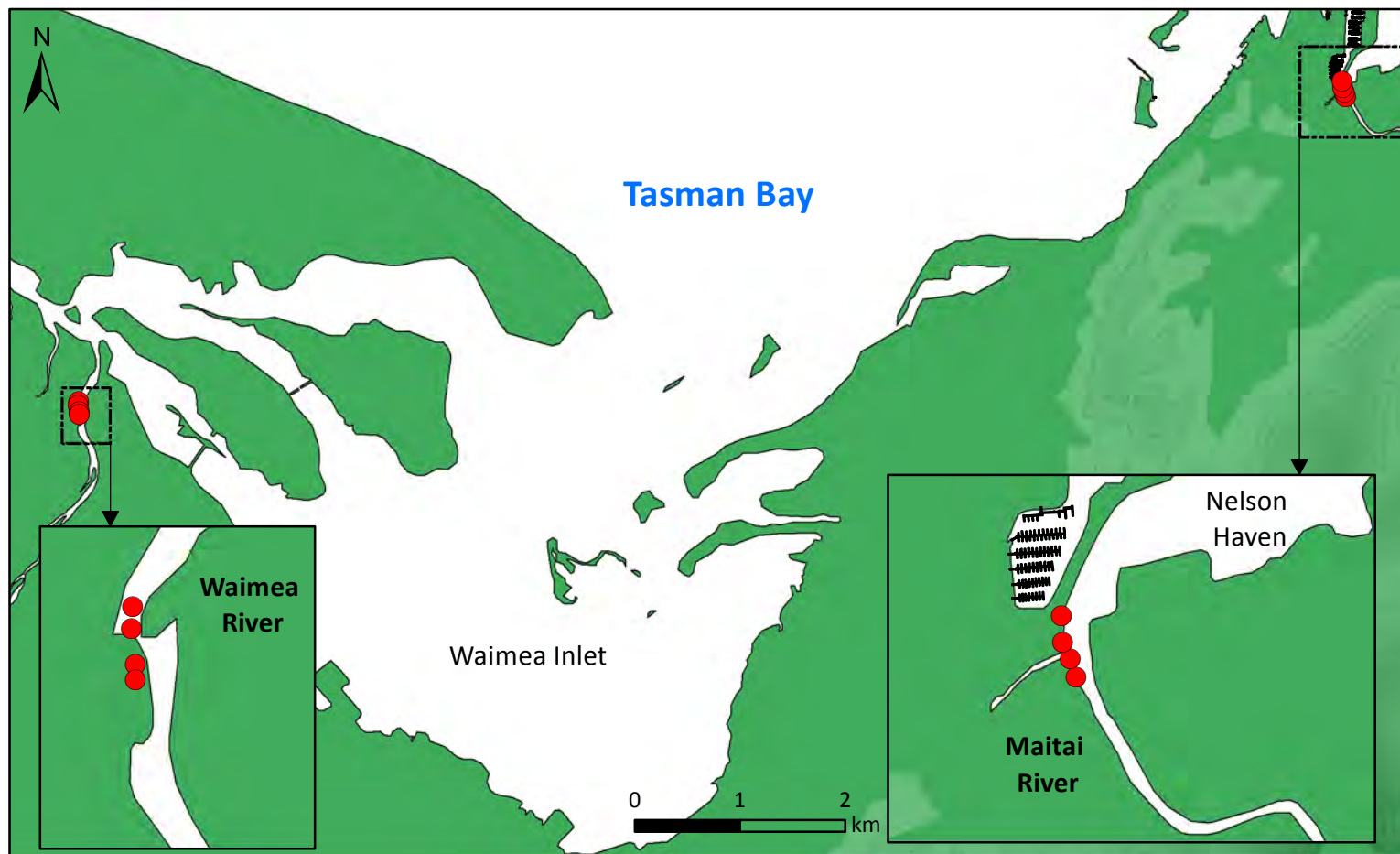
Benthic sled (BSLD) locations



Nelson Harbour and Waimea Inlet

Winter 2017

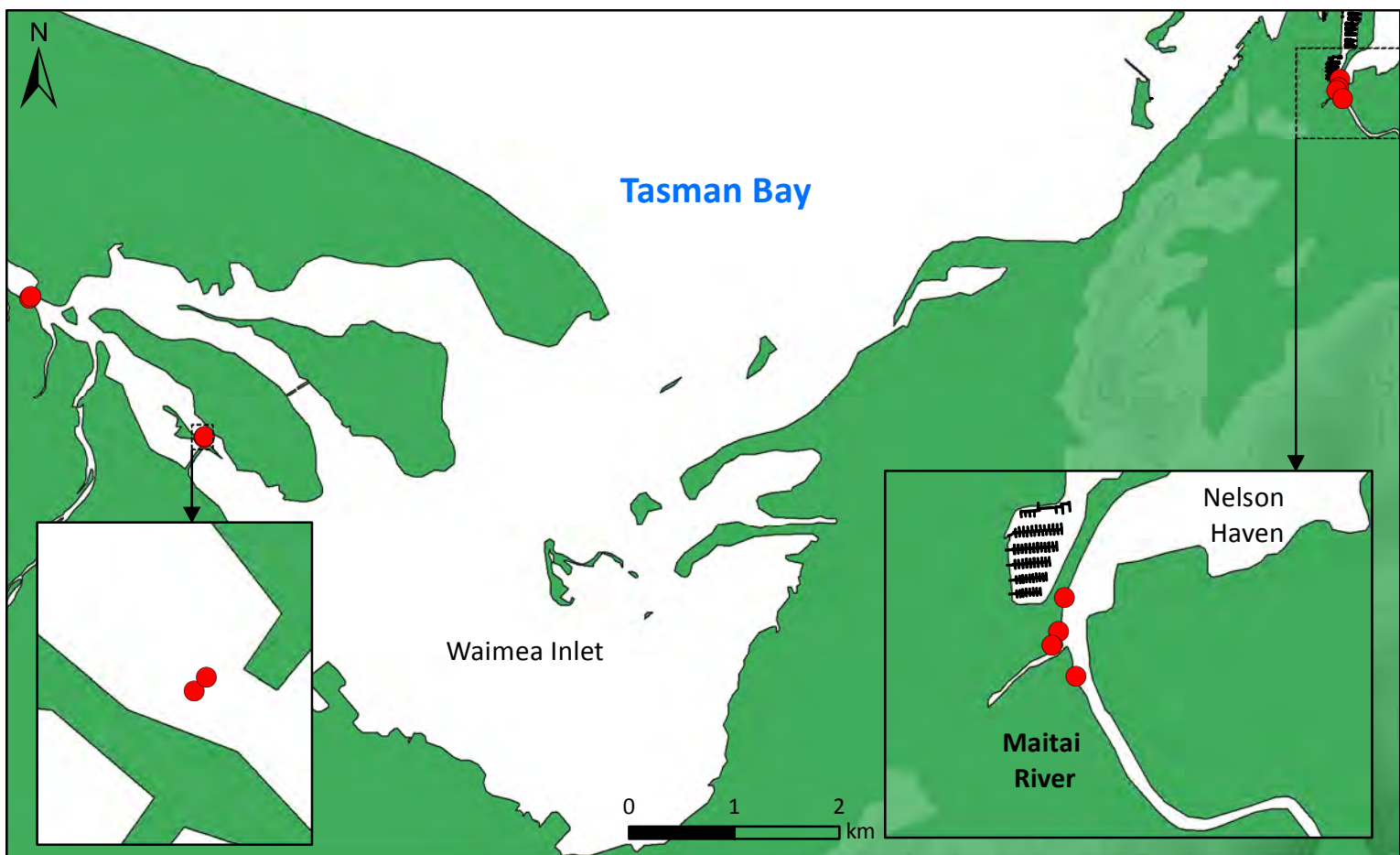
Crab condo (CONDO) locations



Nelson Harbour and Waimea Inlet

Summer 2017-18

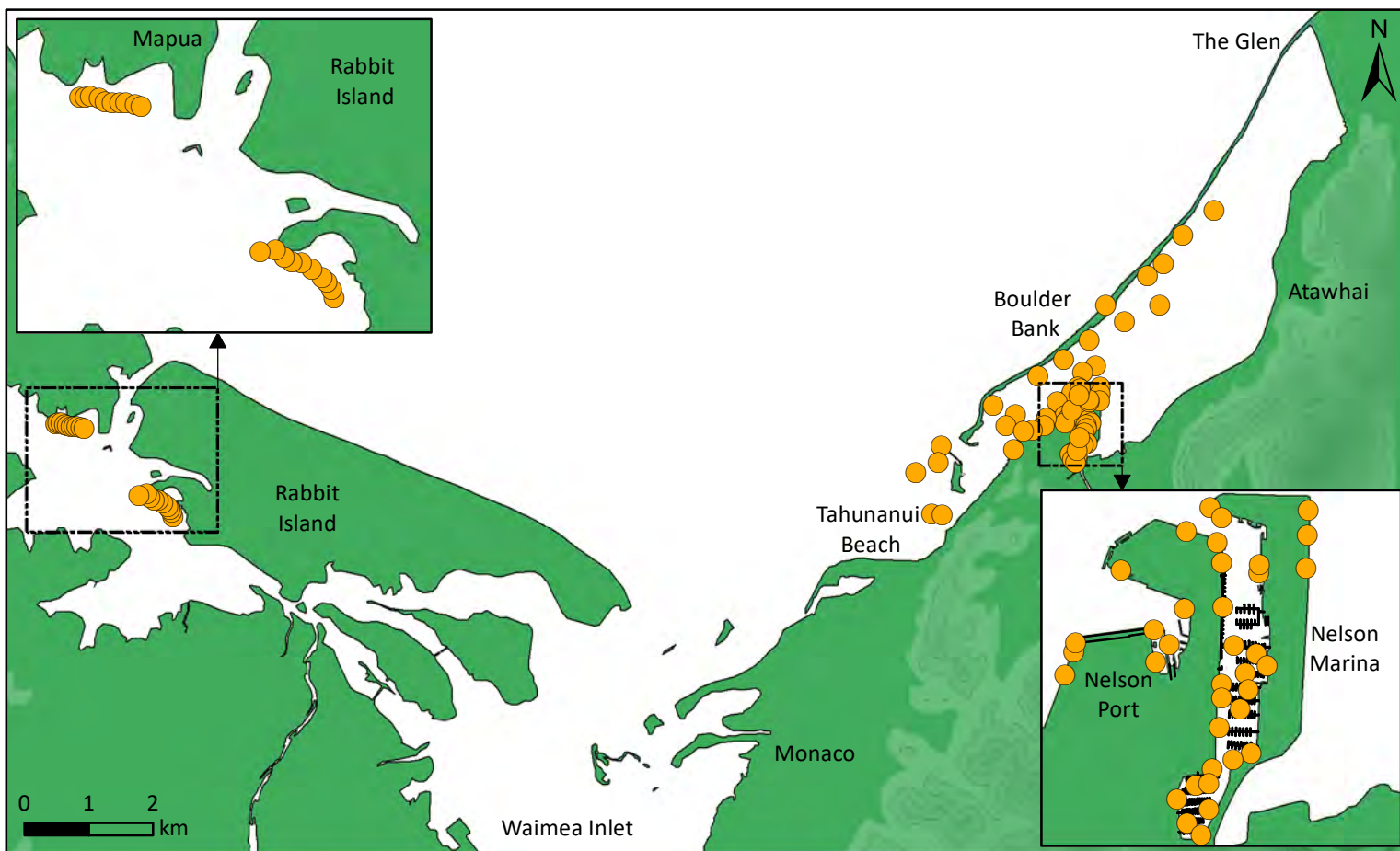
Crab condo (CONDO) locations



Nelson Harbour and Waimea Inlet

Winter 2017

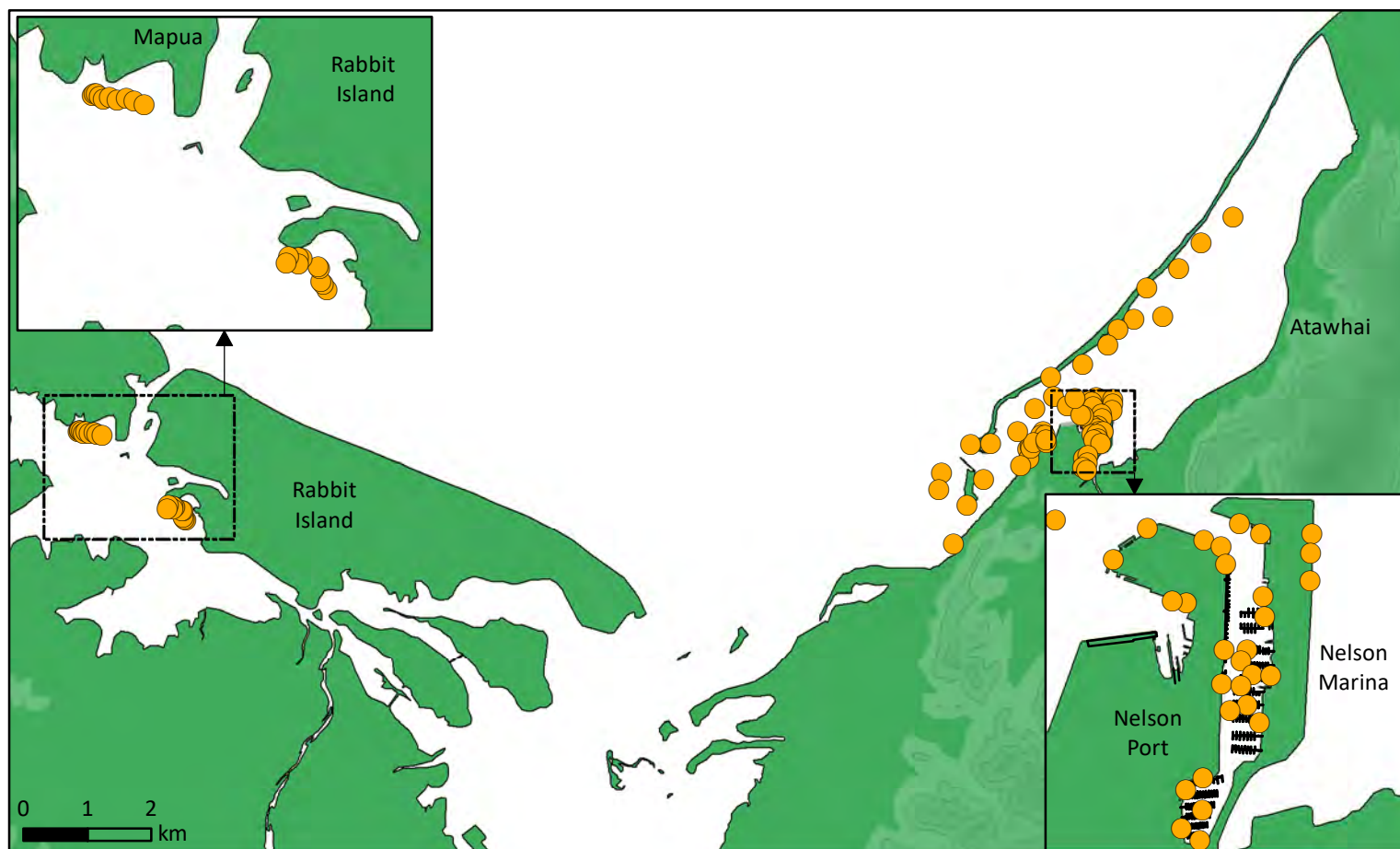
Crab trap (CRBTP) locations



Nelson Harbour and Waimea Inlet

Summer 2017-18

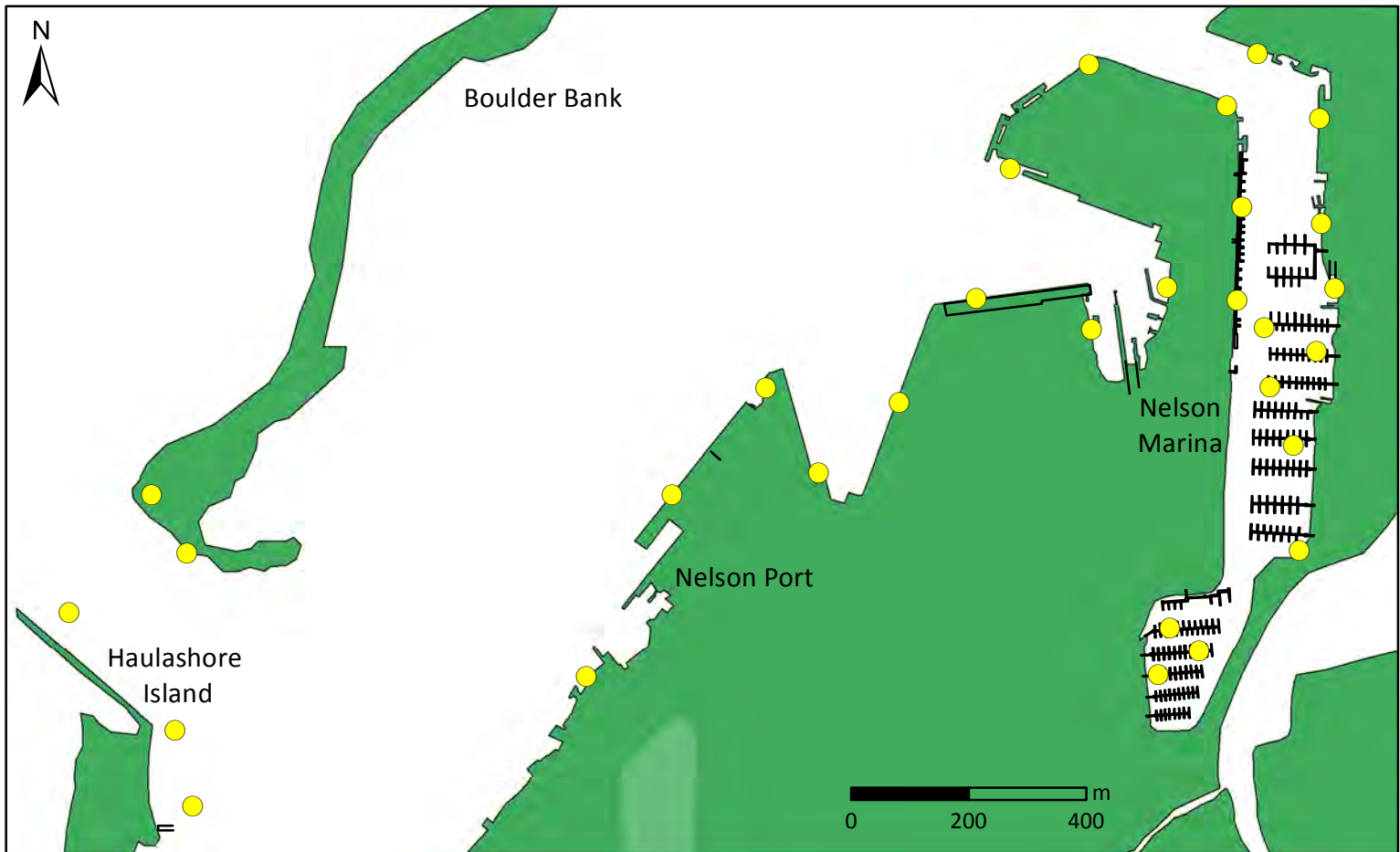
Crab trap (CRBTP) locations



Nelson Harbour and Waimea Inlet

Winter 2017

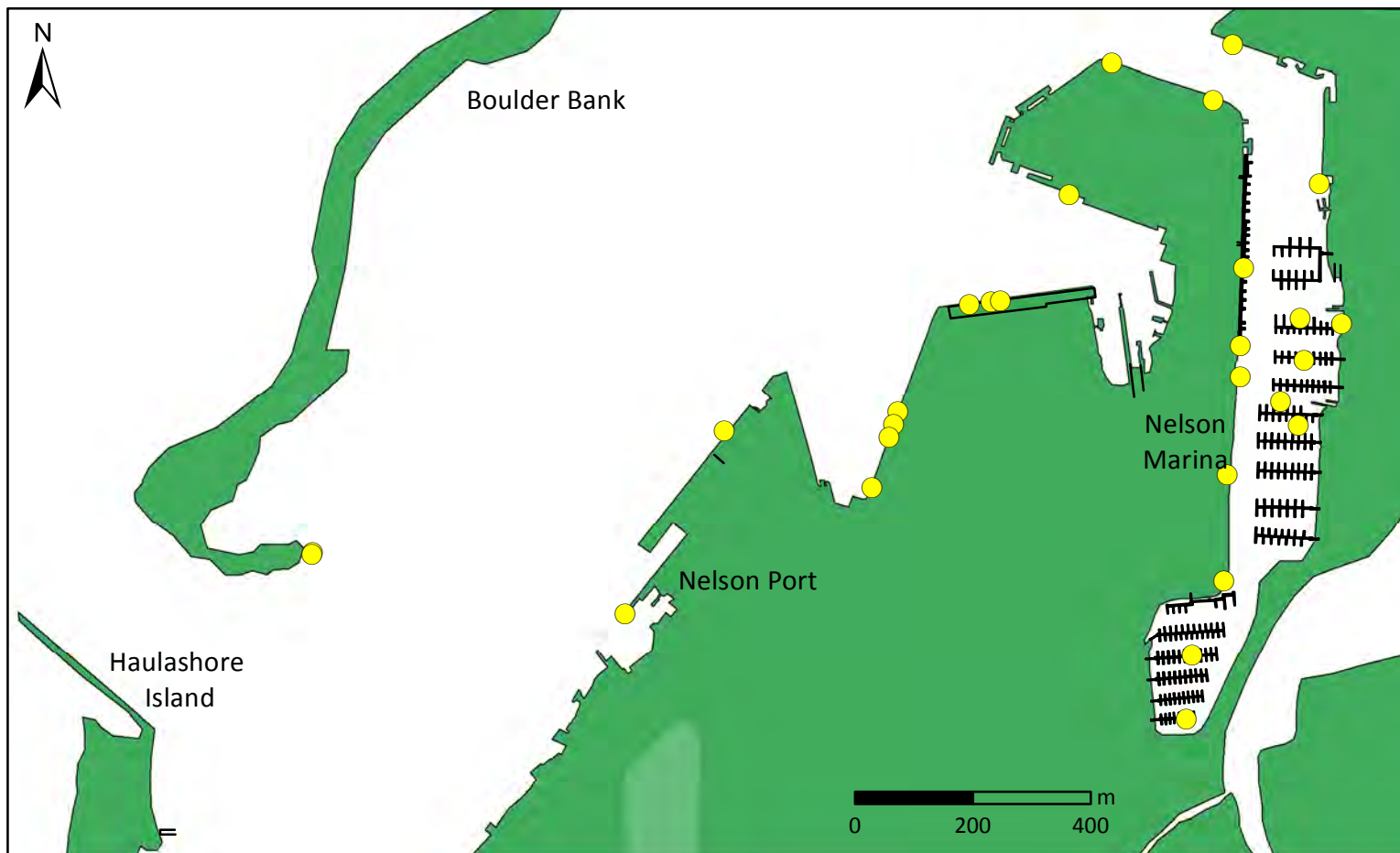
Diver search (VISD) locations



Nelson Harbour and Waimea Inlet

Summer 2017-18

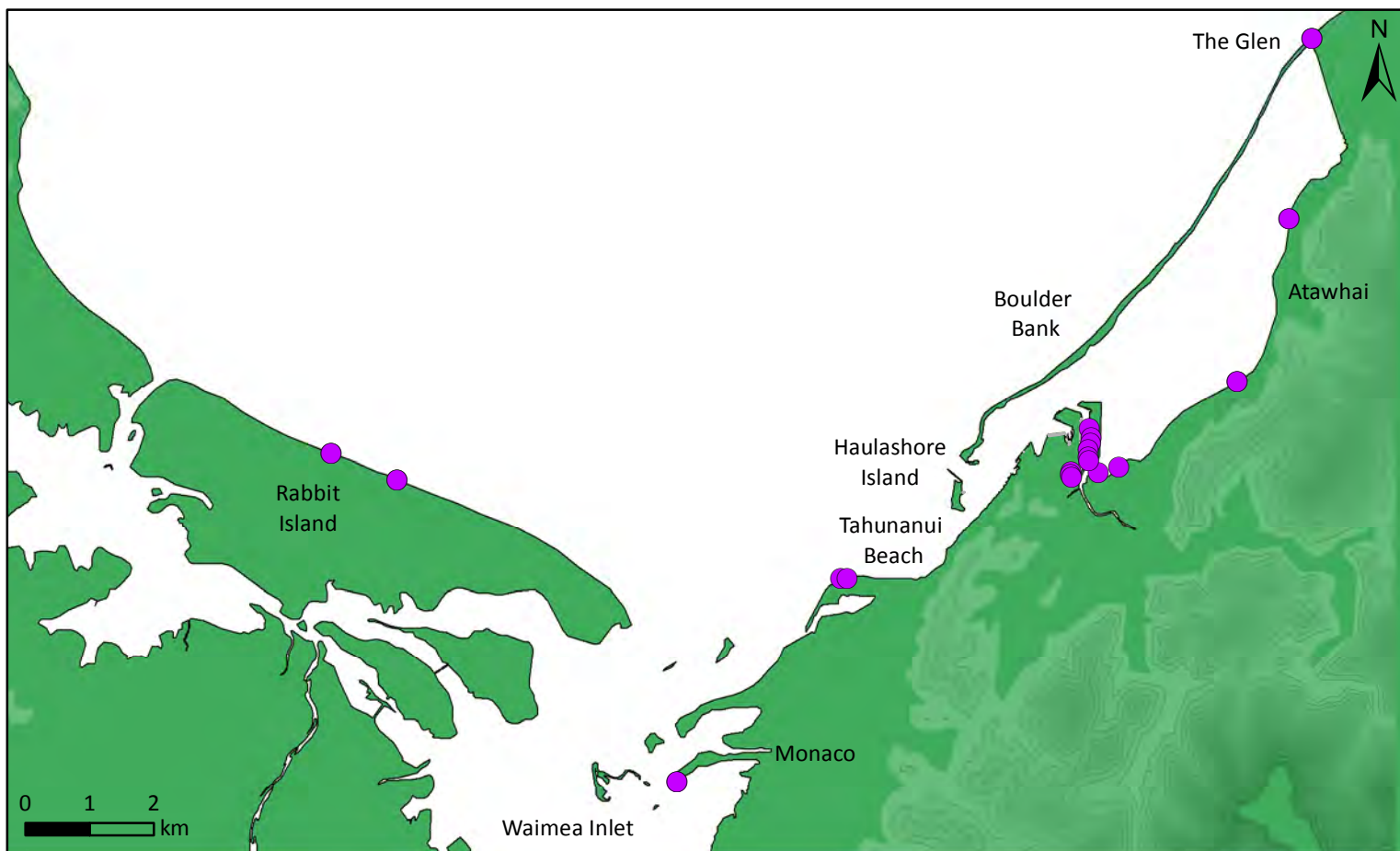
Diver search (VISD) locations



Nelson Harbour and Waimea Inlet

Winter 2017

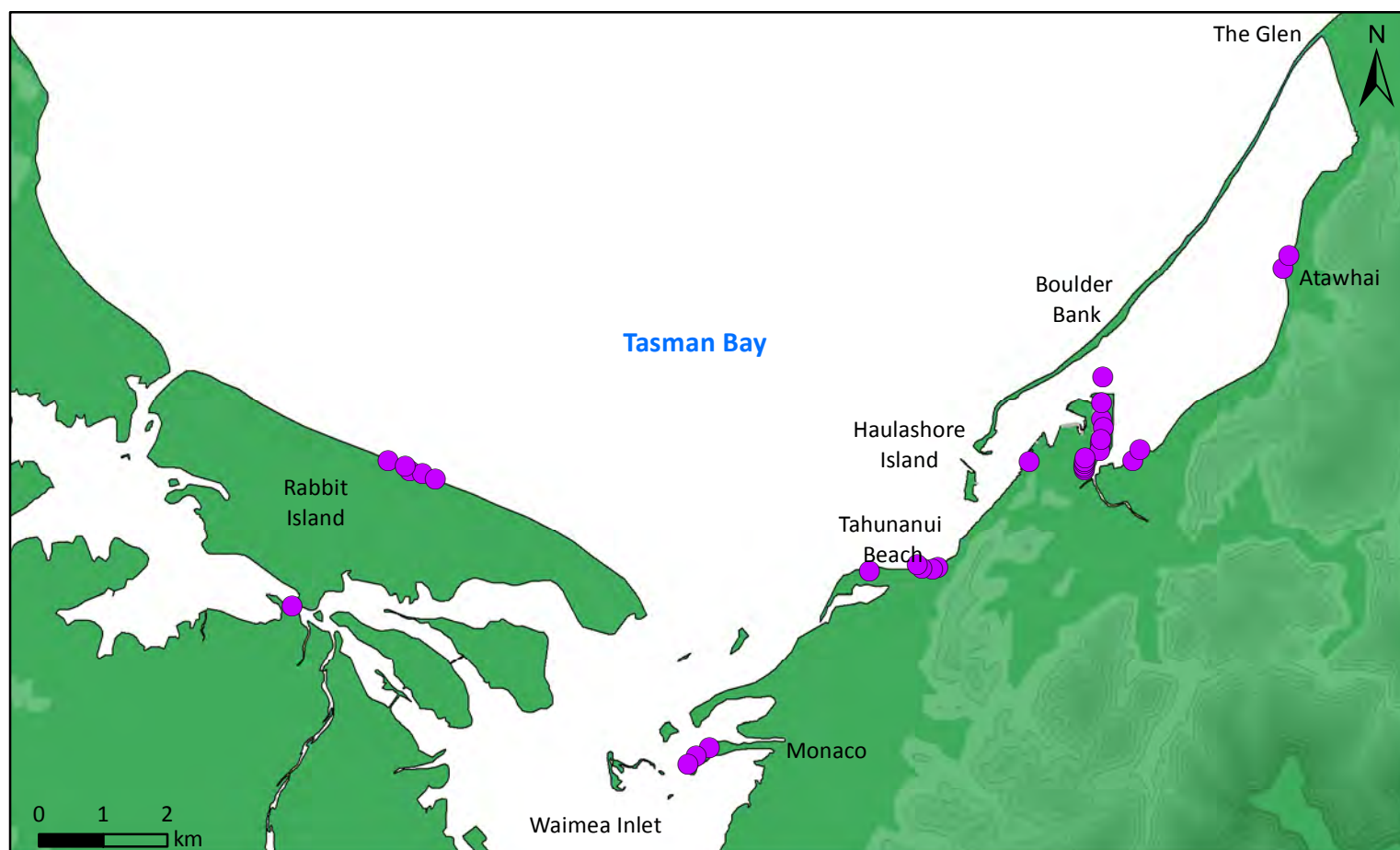
Shore search (WRACK) locations



Nelson Harbour and Waimea Inlet

Summer 2017-18

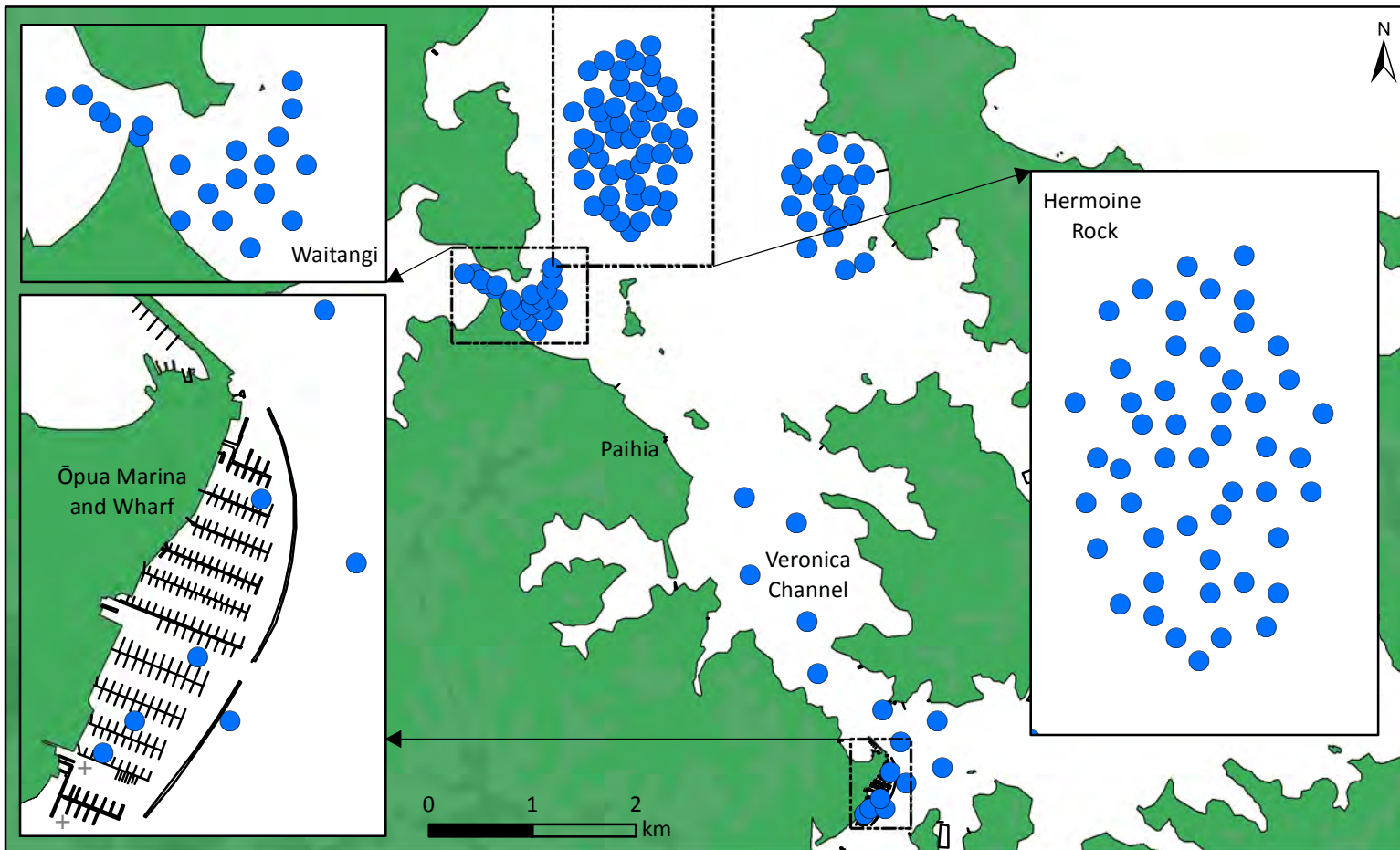
Shore search (WRACK) locations



Ōpua Marina and Waikare Inlet

Winter 2017

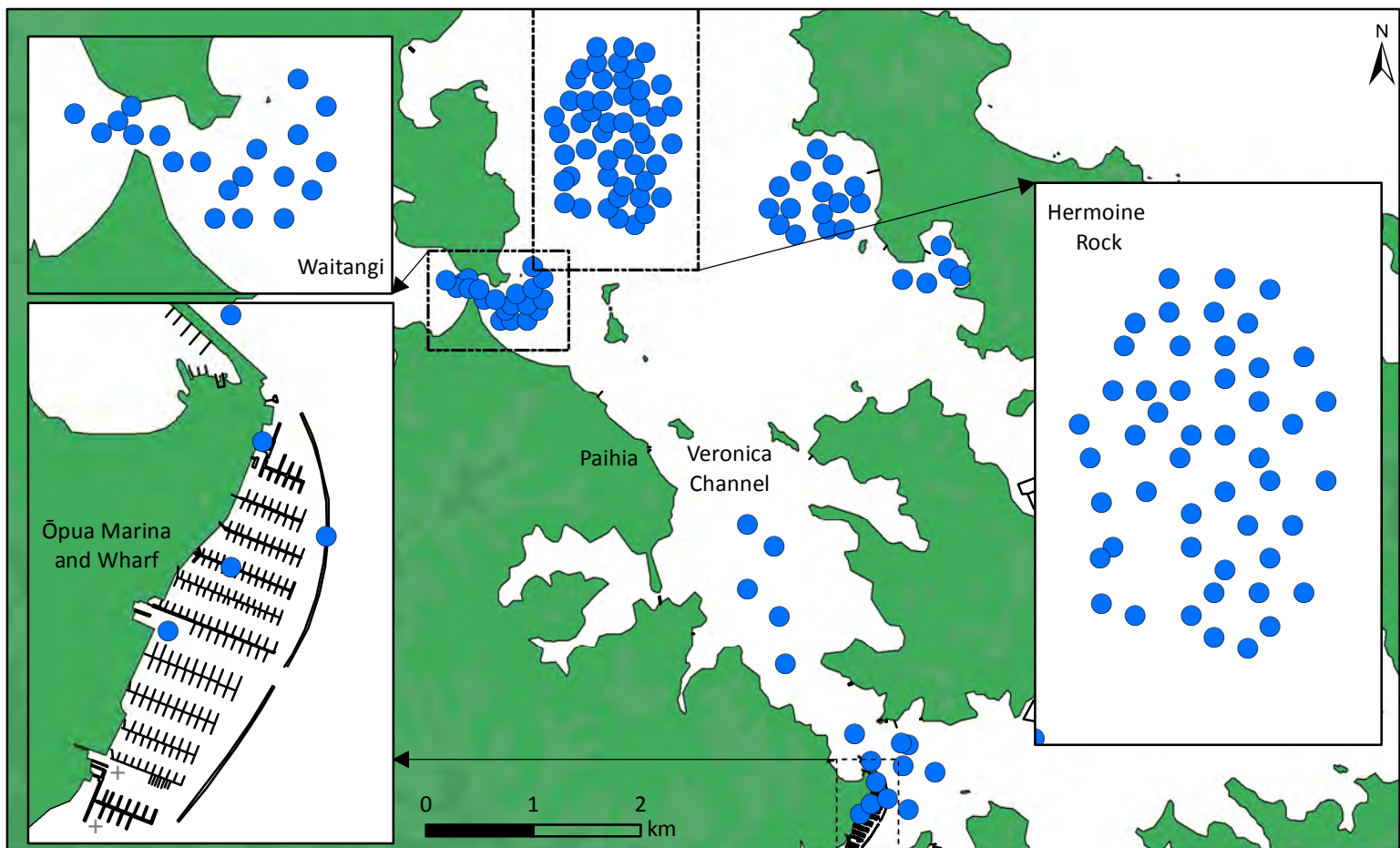
Benthic sled (BSLD) locations



Ōpua Marina and Waikare Inlet

Summer 2017-18

Benthic sled (BSLD) locations



Ōpua Marina and Waikare Inlet

Winter 2017

Crab condo (CONDO) locations



Ōpua Marina and Waikare Inlet

Summer 2017-18

Crab condo (CONDO) locations



Ōpua Marina and Waikare Inlet

Winter 2017

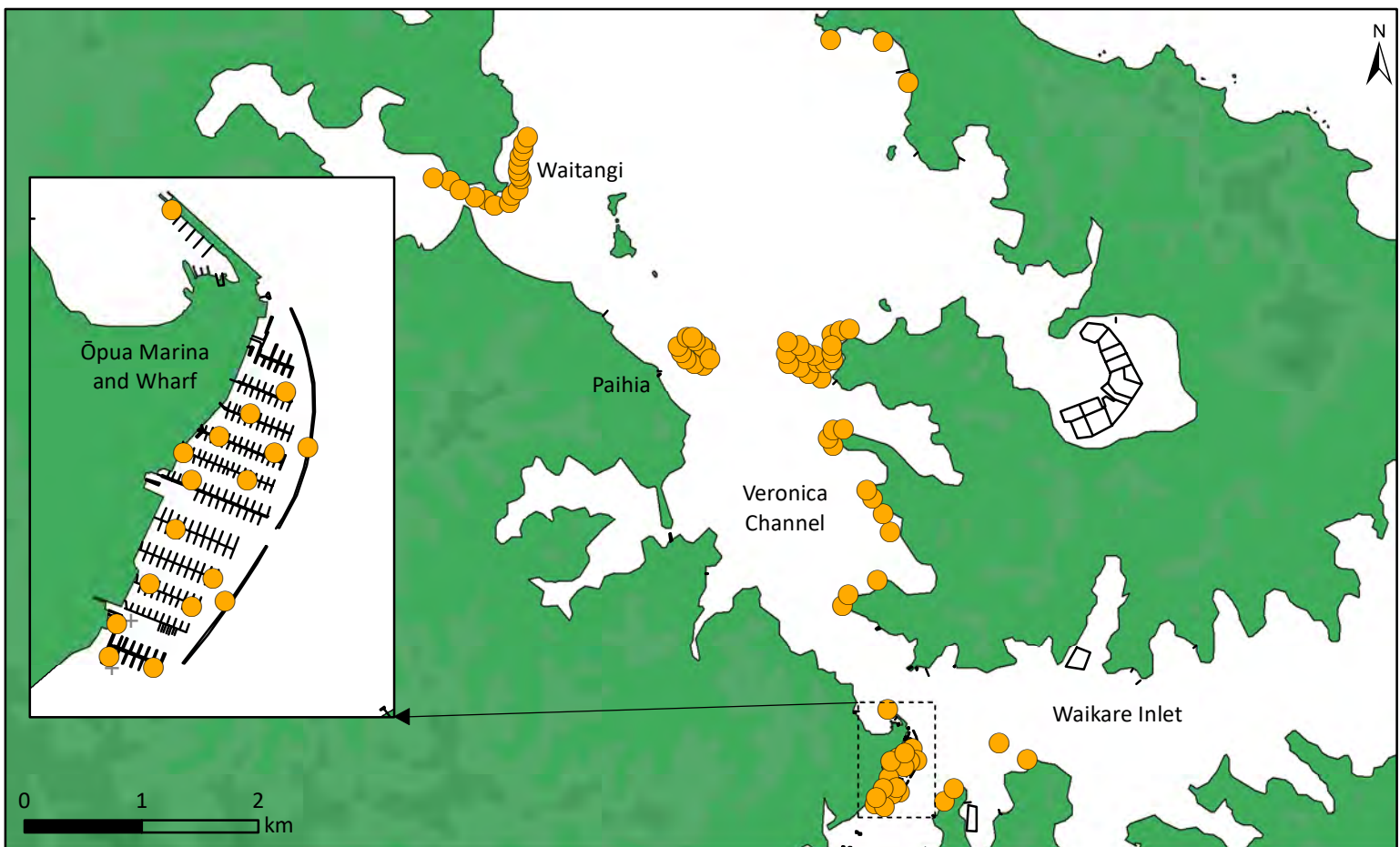
Crab trap (CRBTP) locations



Ōpua Marina and Waikare Inlet

Summer 2017-18

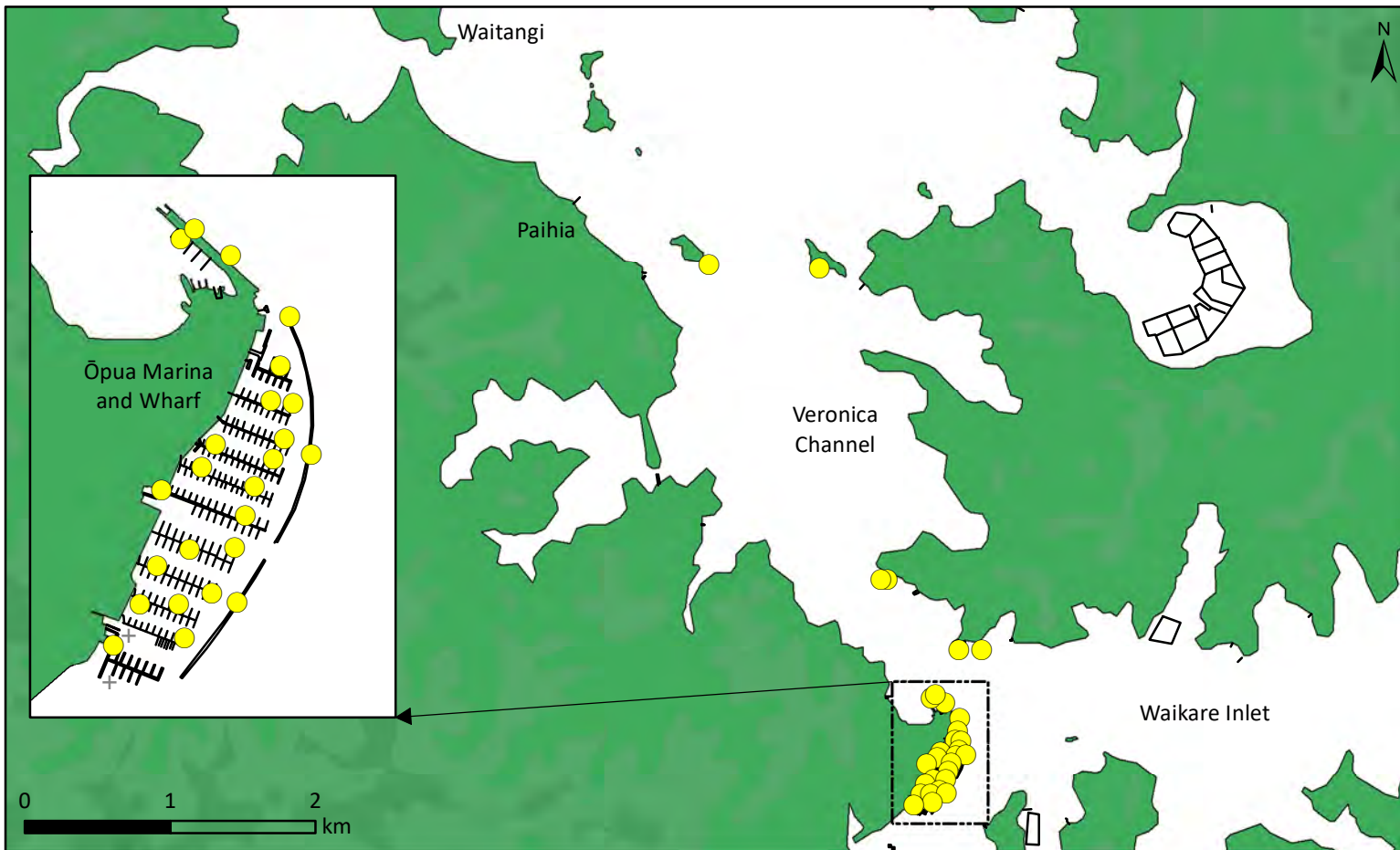
Crab trap (CRBTP) locations



Ōpua Marina and Waikare Inlet

Winter 2017

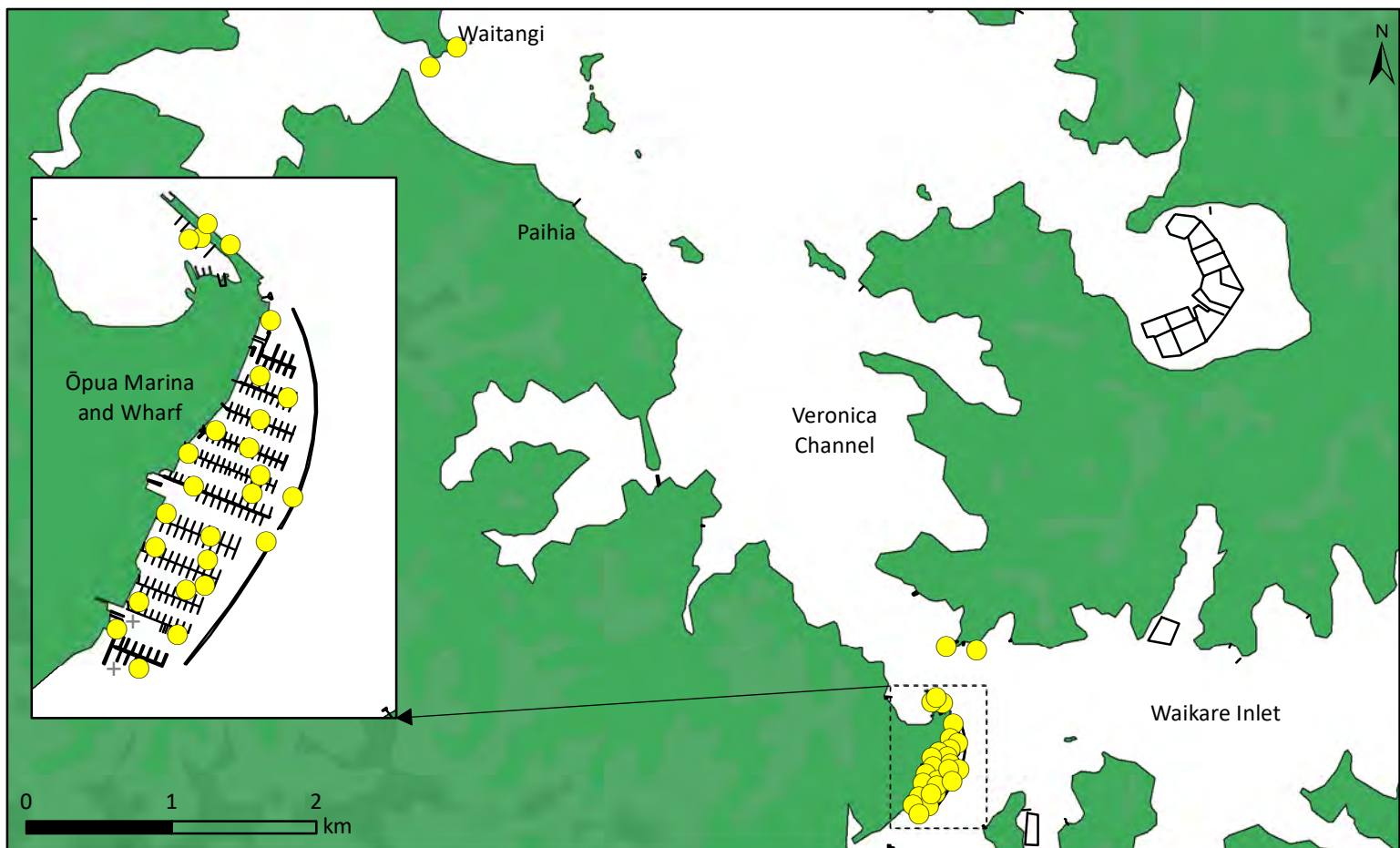
Diver search (VISD) locations



Ōpua Marina and Waikare Inlet

Summer 2017-18

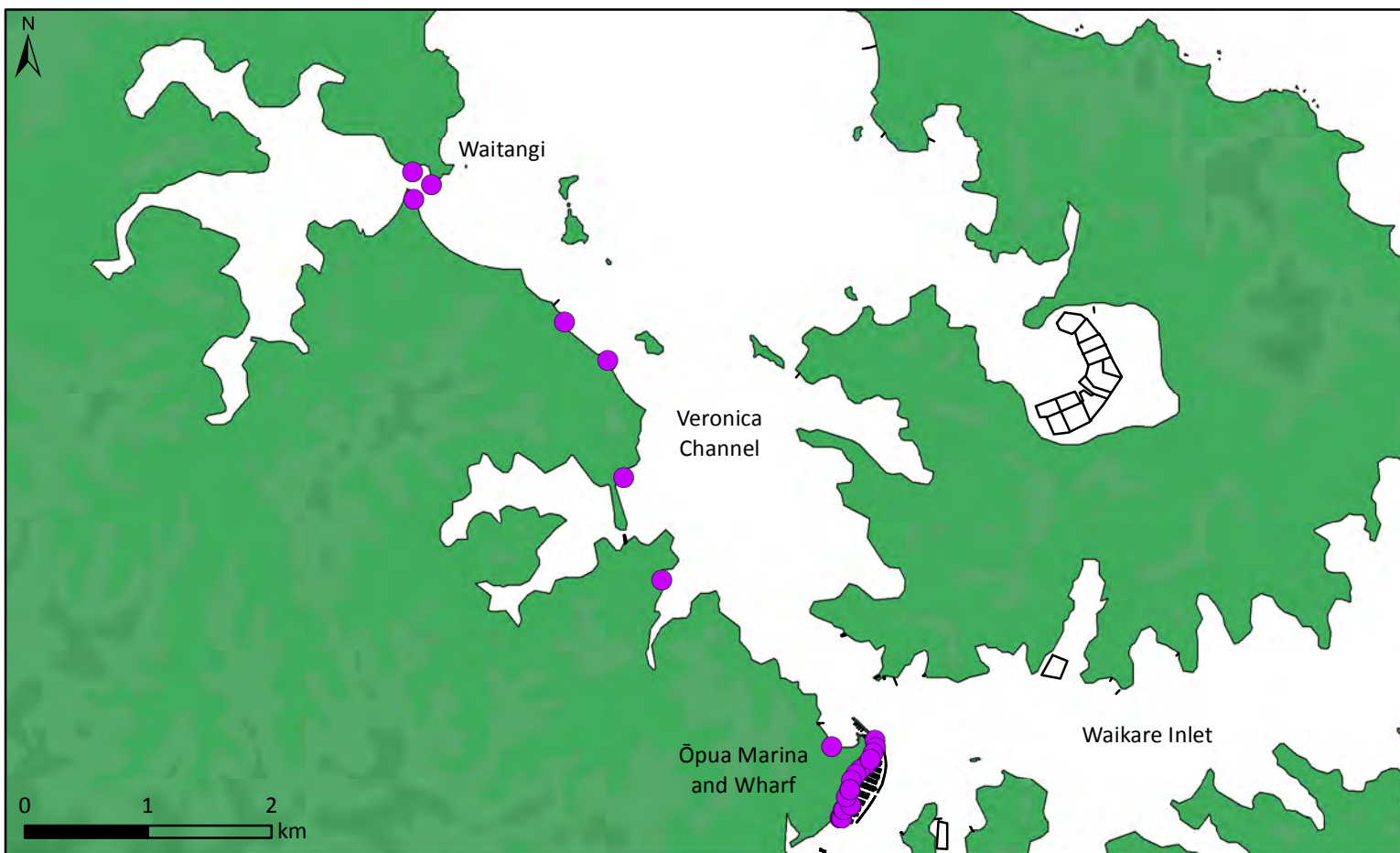
Diver search (VISD) locations



Ōpua Marina and Waikare Inlet

Winter 2017

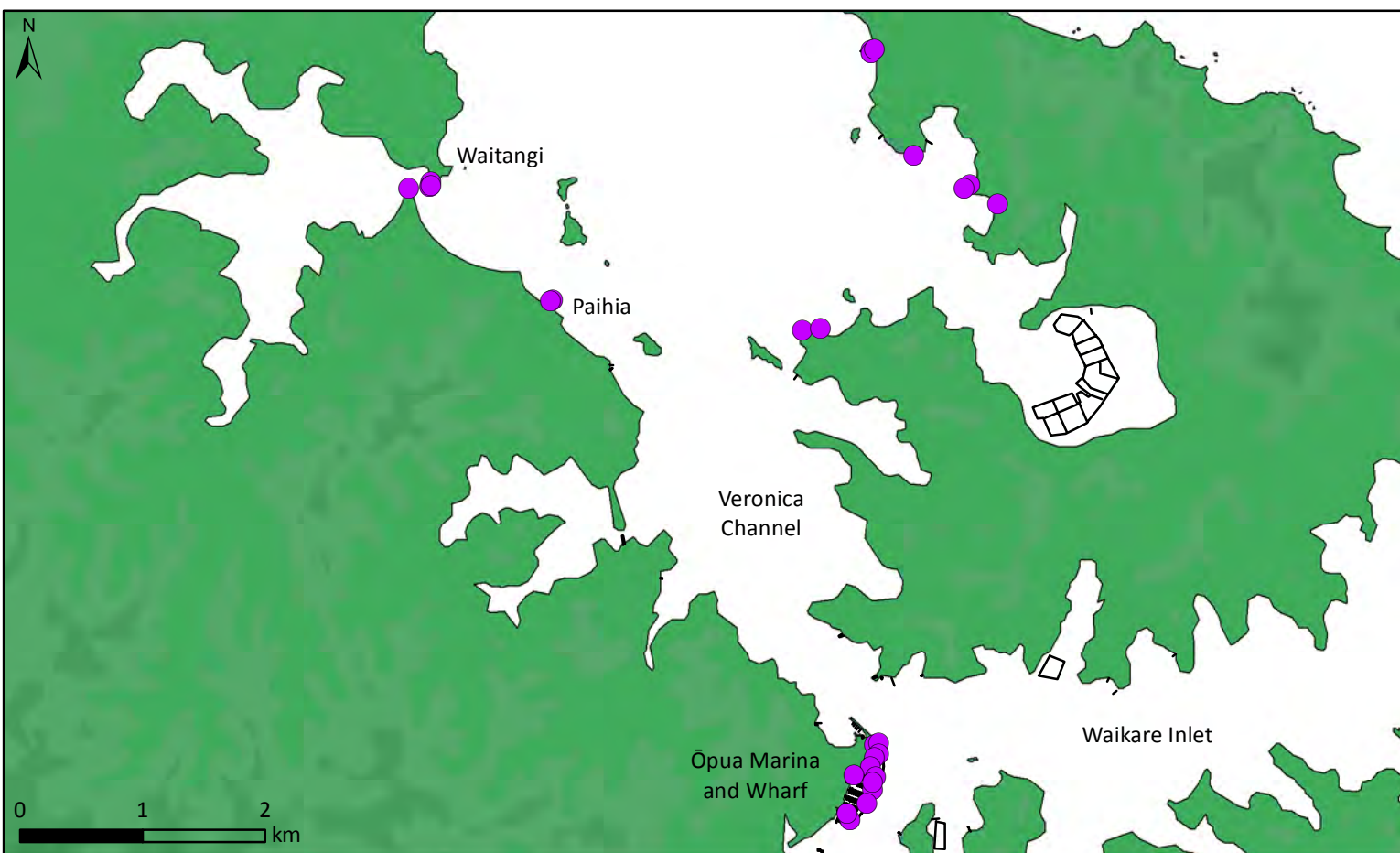
Shore search (WRACK) locations



Ōpua Marina and Waikare Inlet

Summer 2017-18

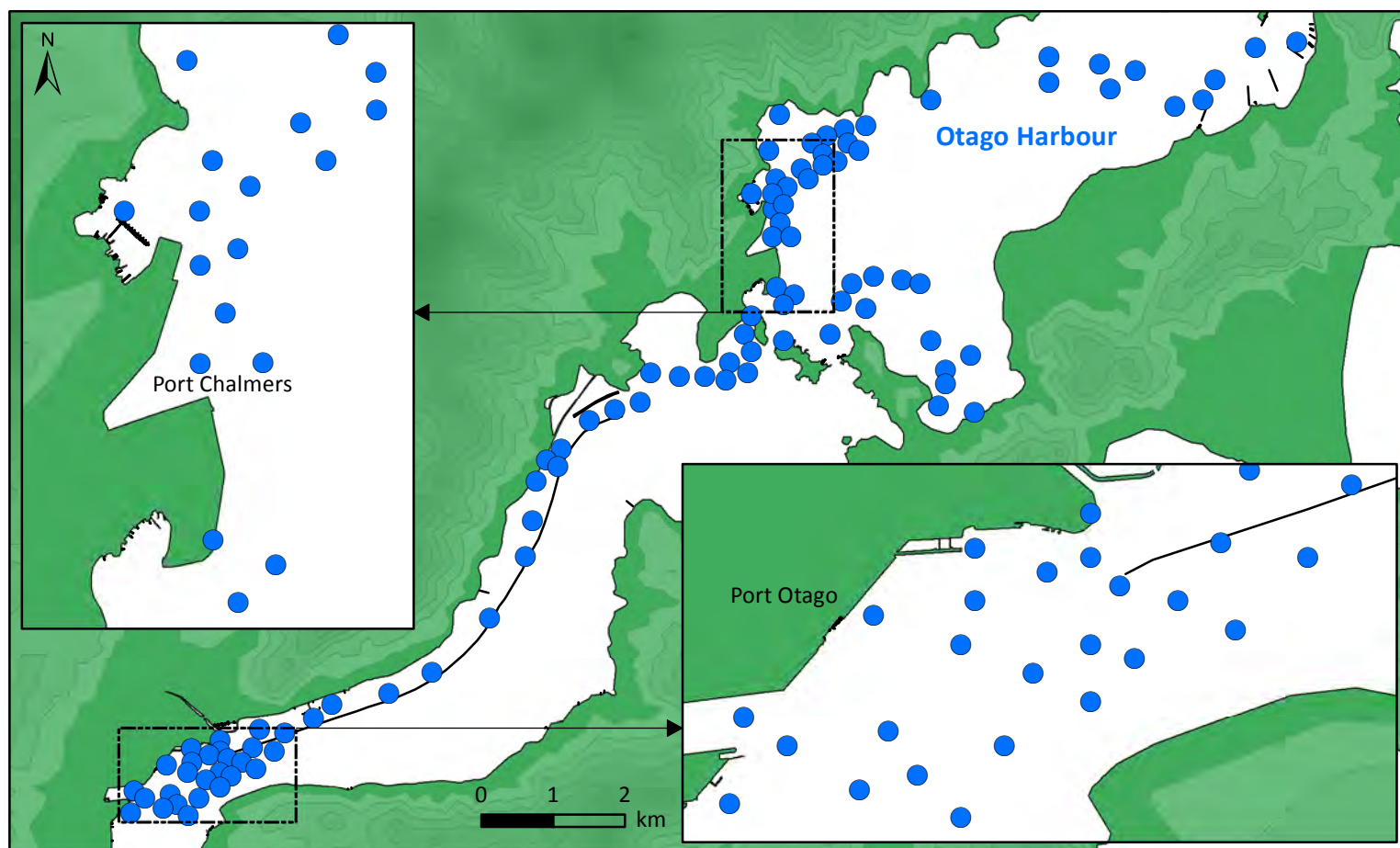
Shore search (WRACK) locations



Otago Harbour

Winter 2017

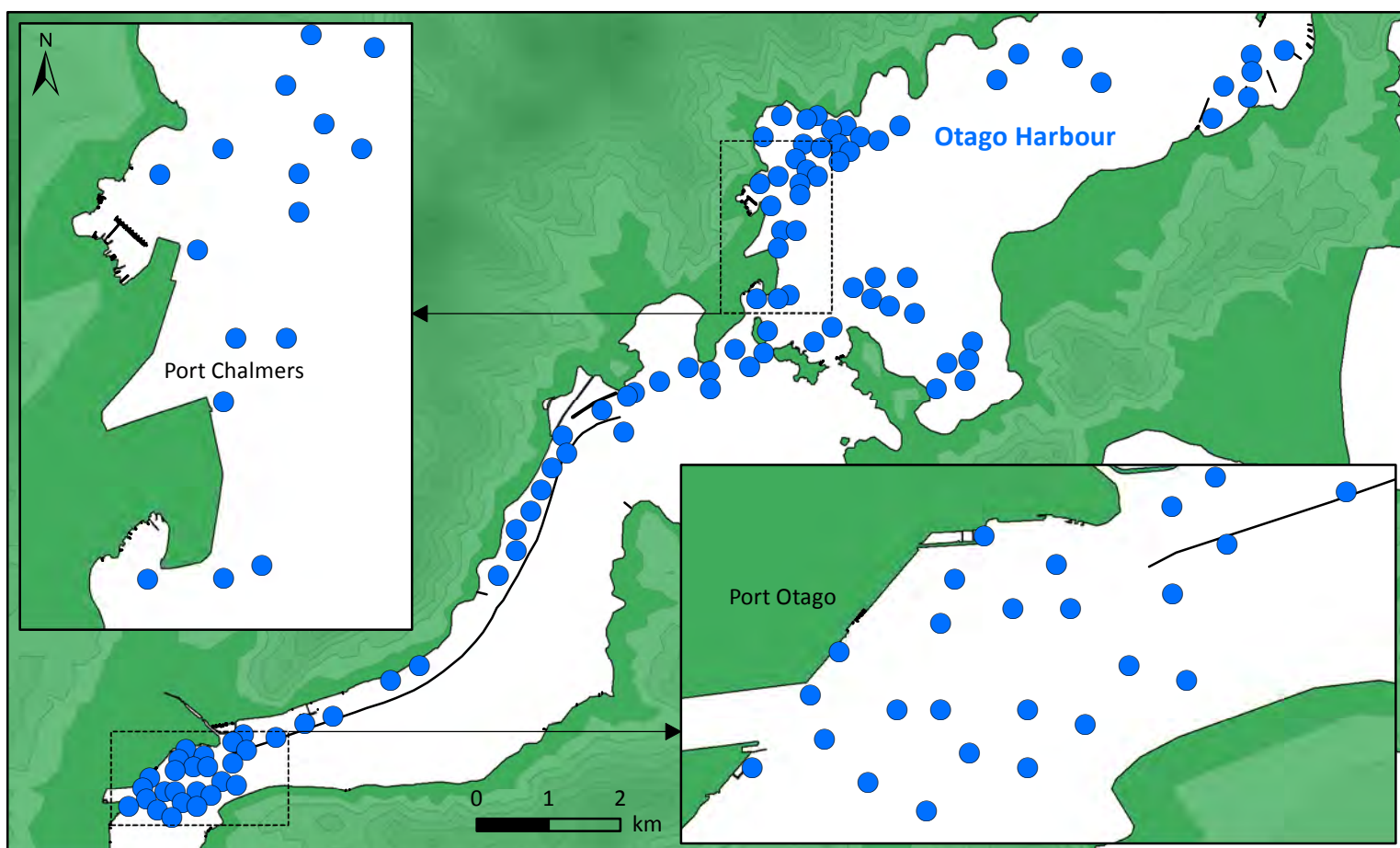
Benthic sled (BSLD) locations



Otago Harbour

Summer 2017-18

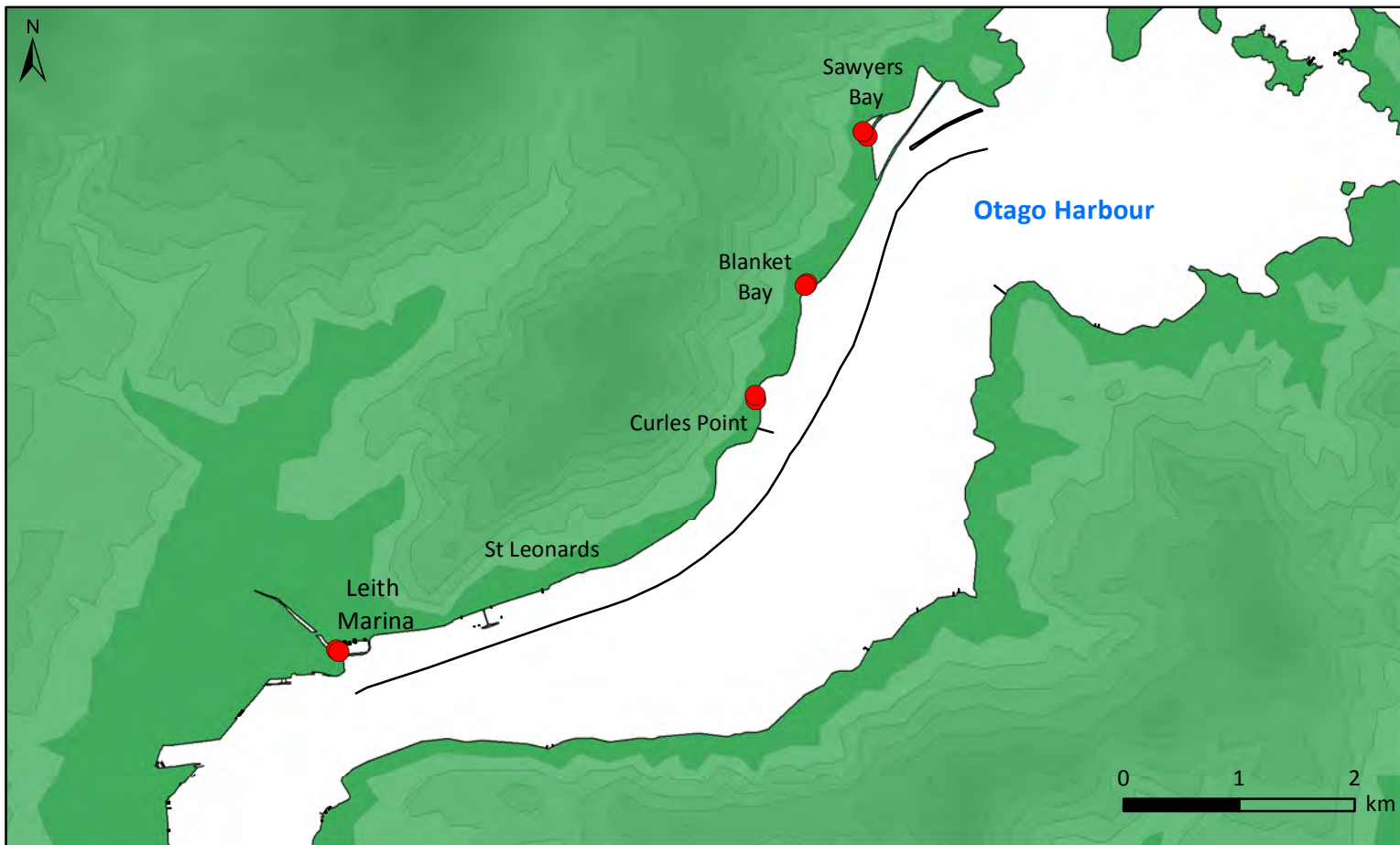
Benthic sled (BSLD) locations



Otago Harbour

Winter 2017

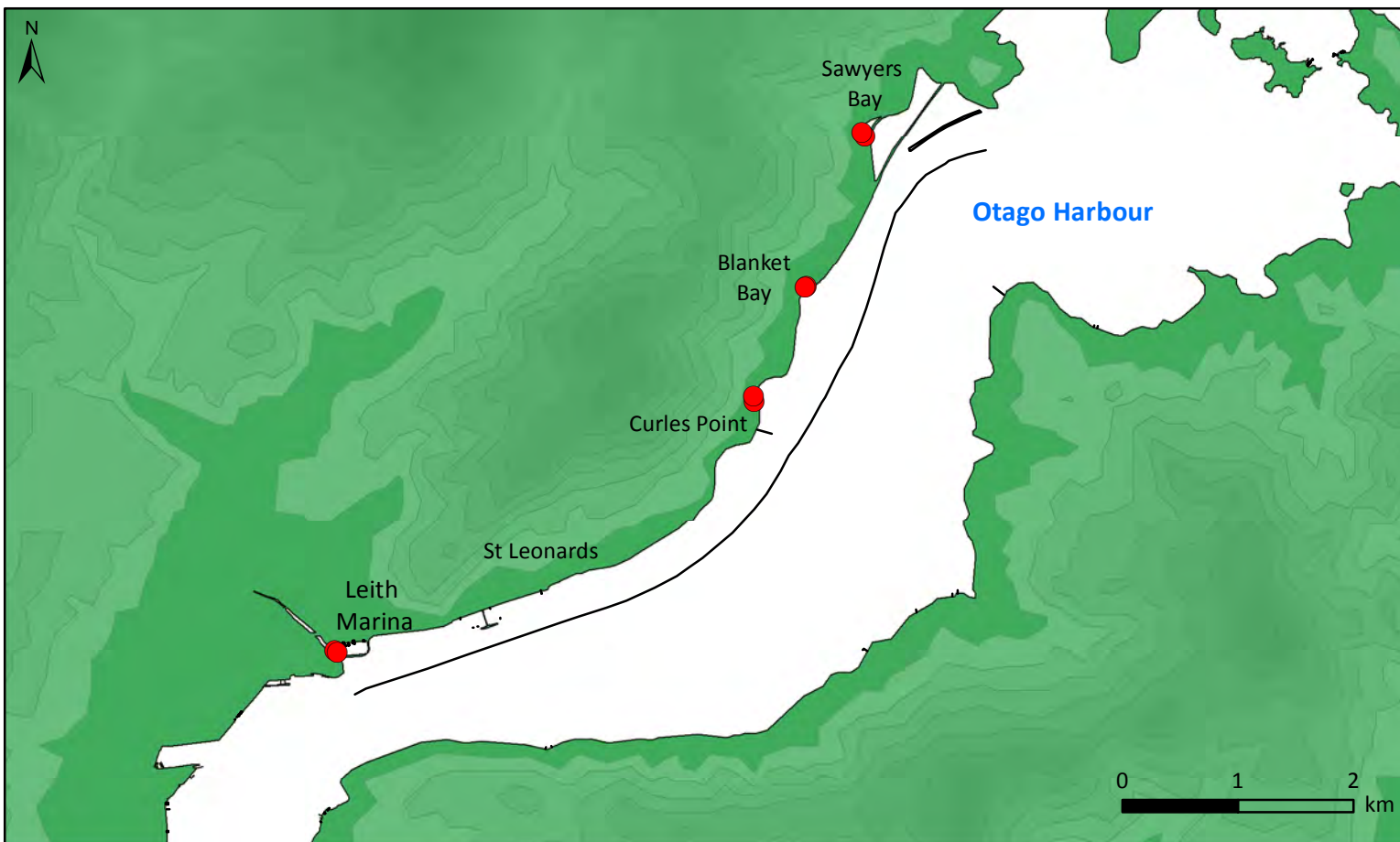
Crab condo (CONDO) locations



Otago Harbour

Summer 2017-18

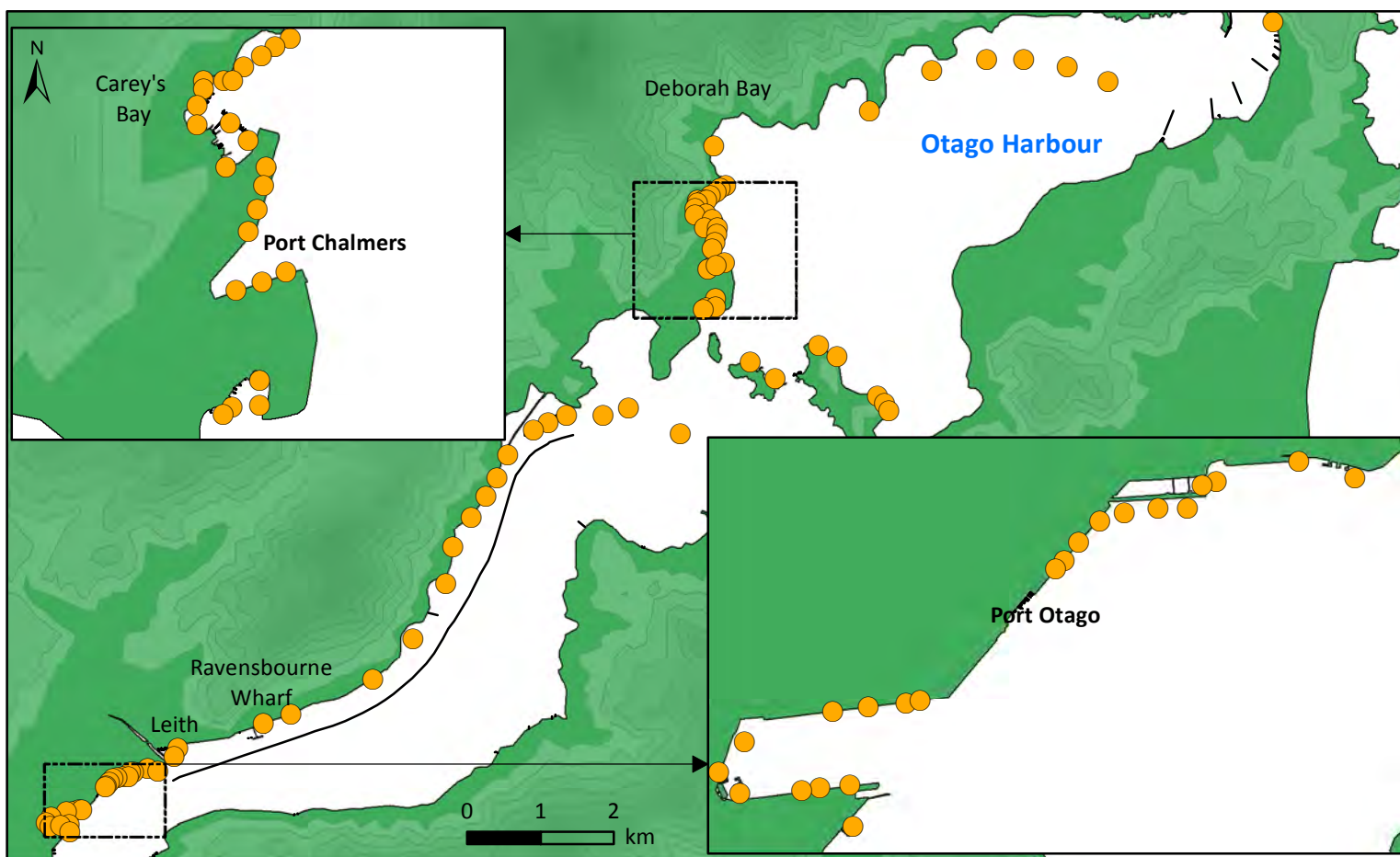
Crab condo (CONDO) locations



Otago Harbour

Winter 2017

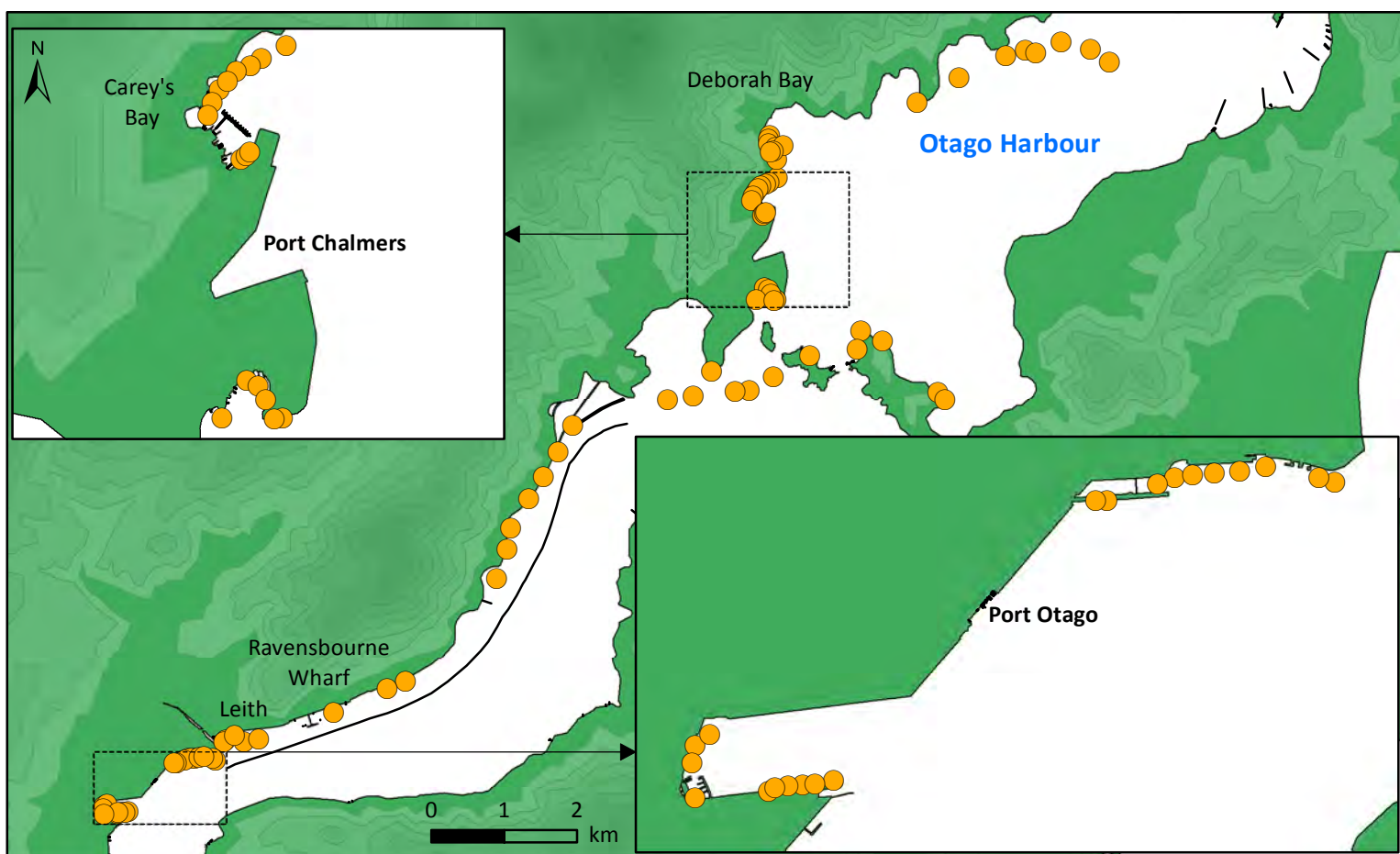
Crab trap (CRBTP) locations



Otago Harbour

Summer 2017-18

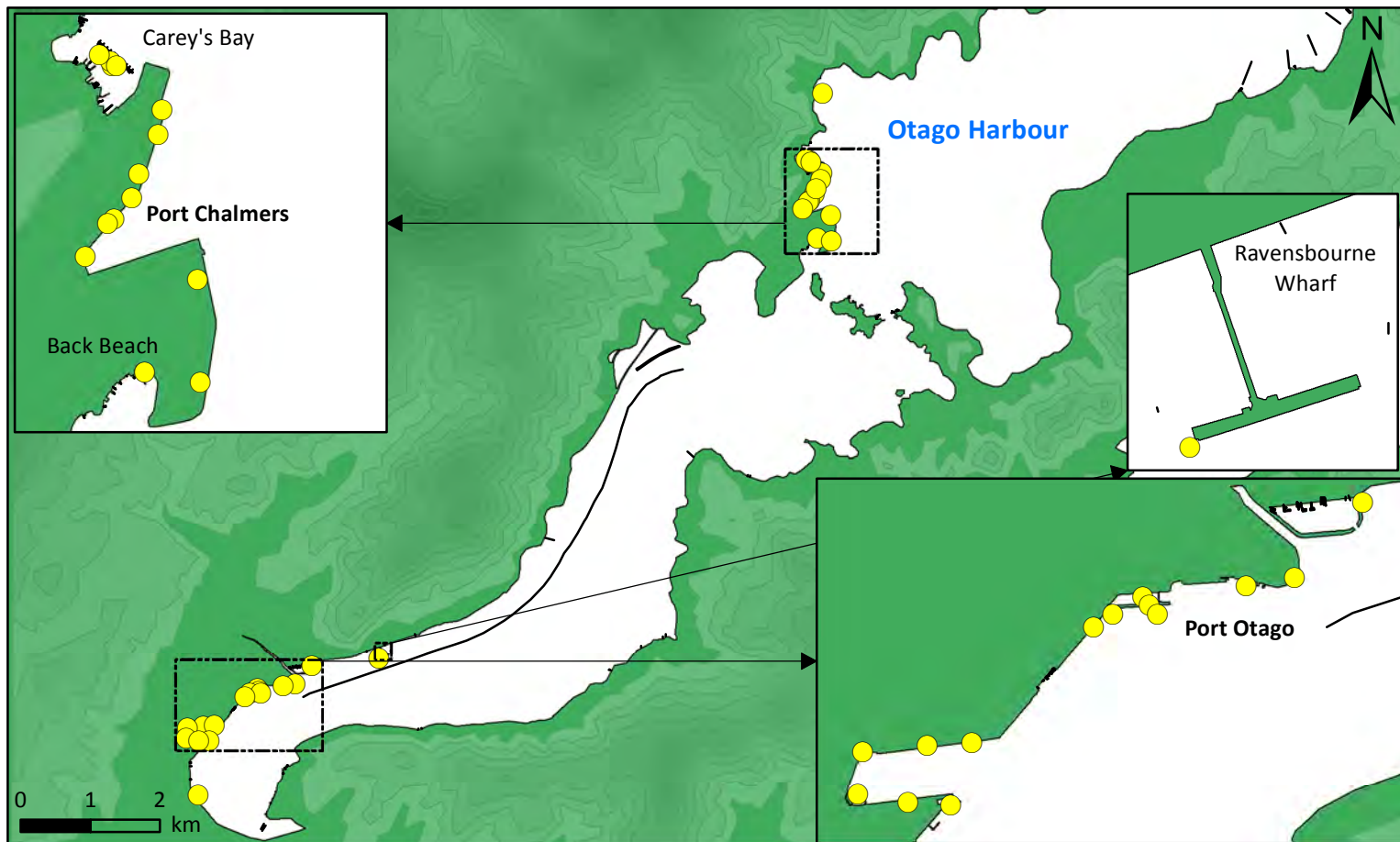
Crab trap (CRBTP) locations



Otago Harbour

Winter 2017

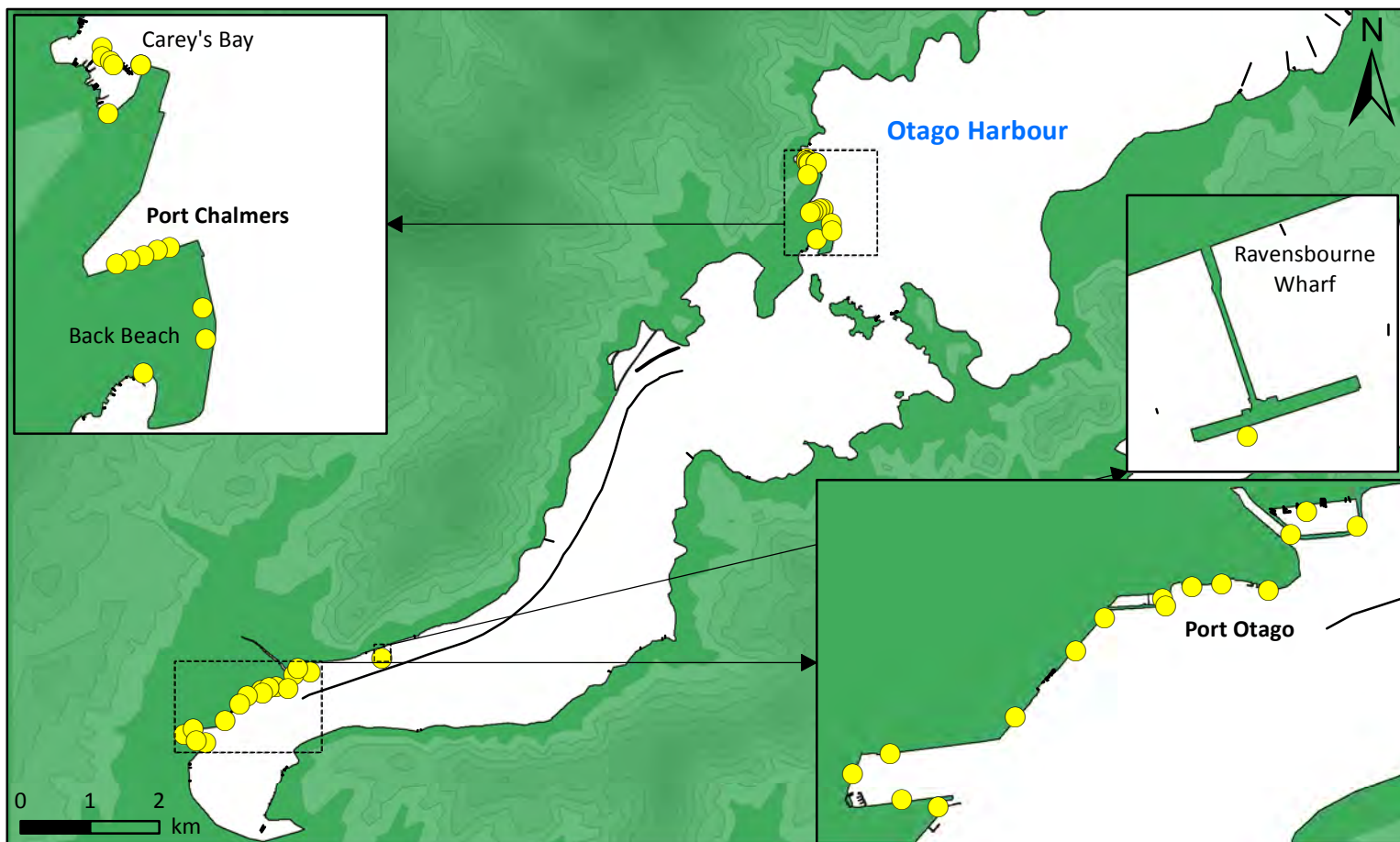
Visual dive (VISD) locations



Otago Harbour

Summer 2017-18

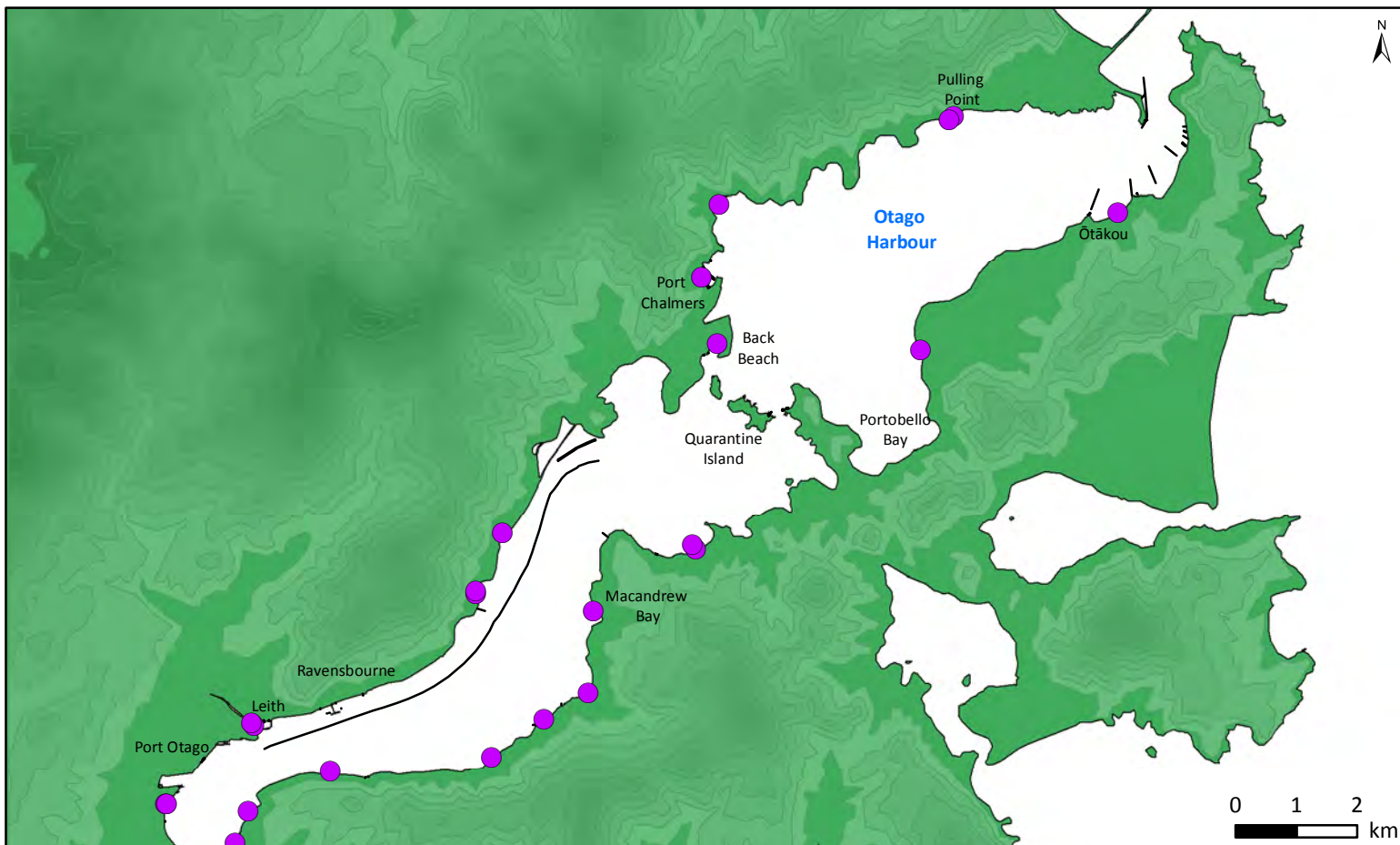
Visual dive (VISD) locations



Otago Harbour

Winter 2017

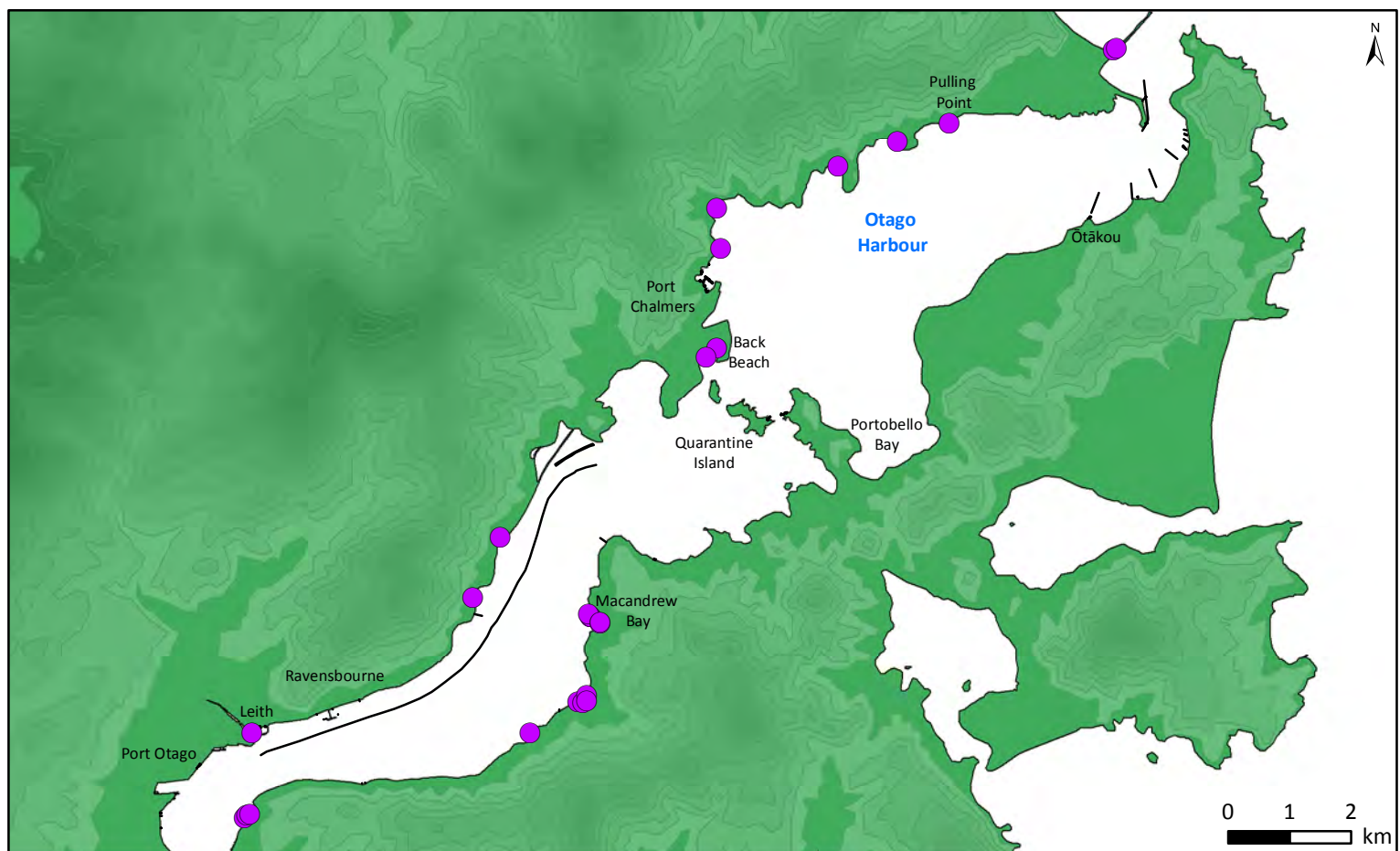
Shore search (WRACK) locations



Otago Harbour

Summer 2017-18

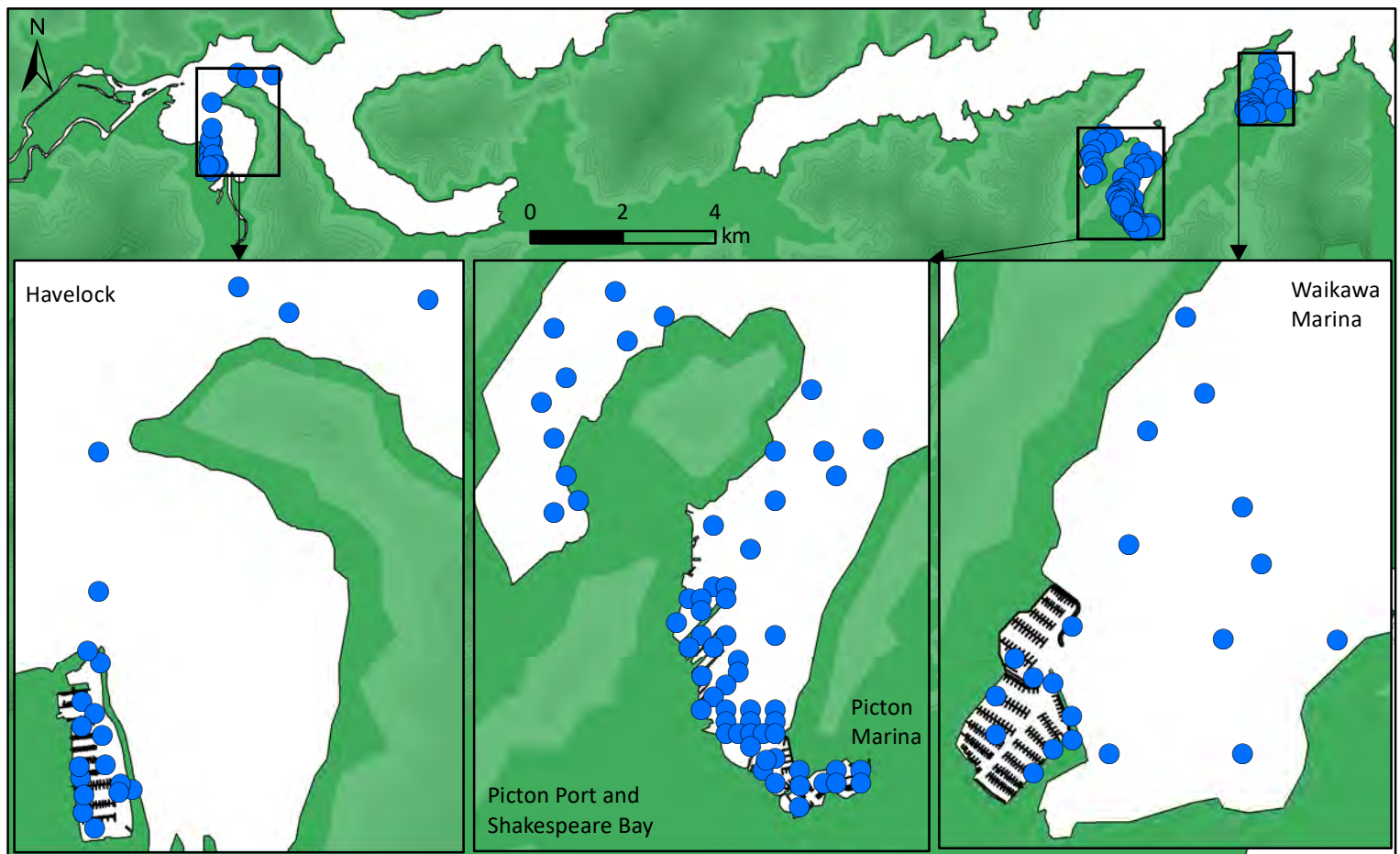
Shore search (WRACK) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

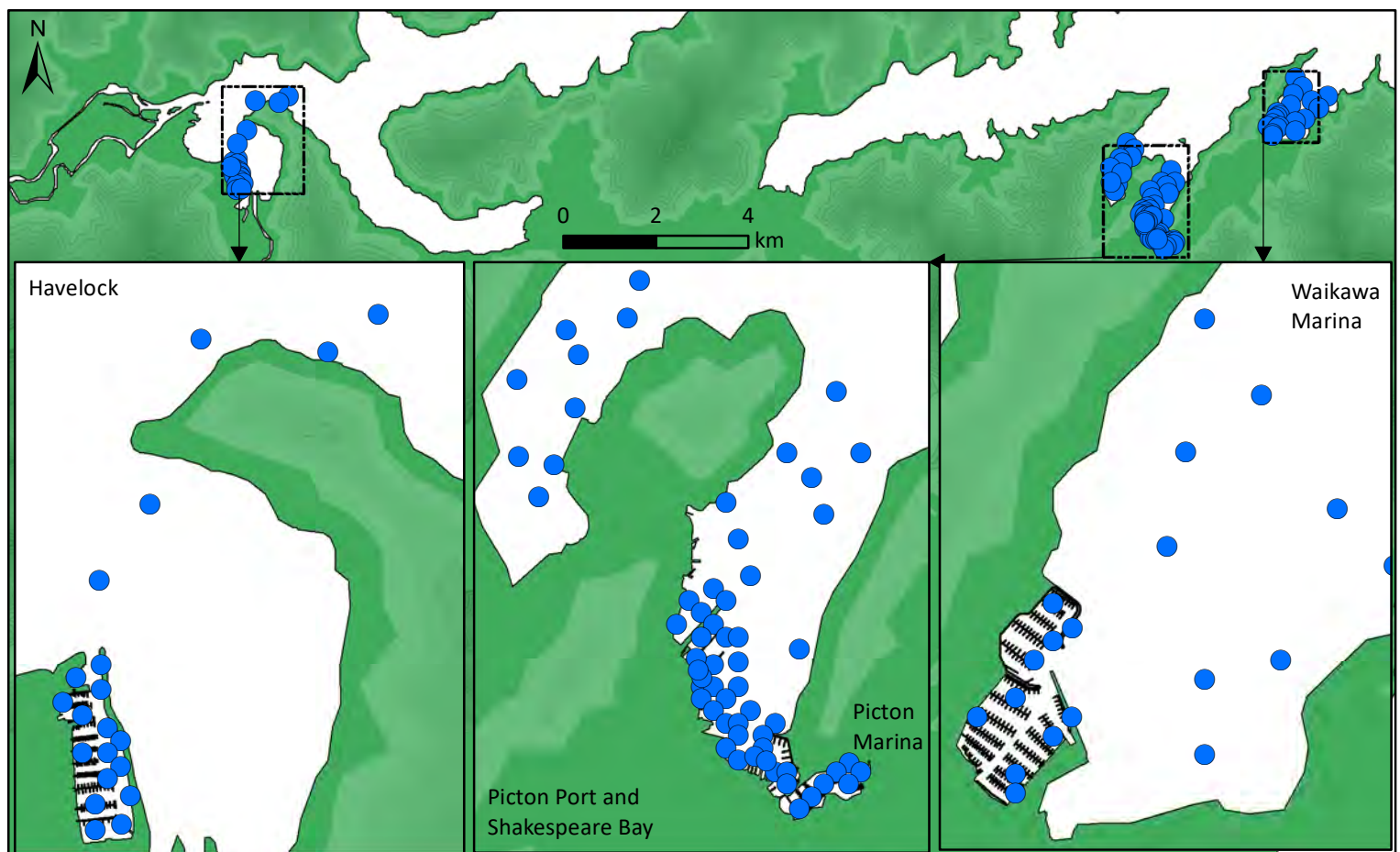
Benthic sled (BSLD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

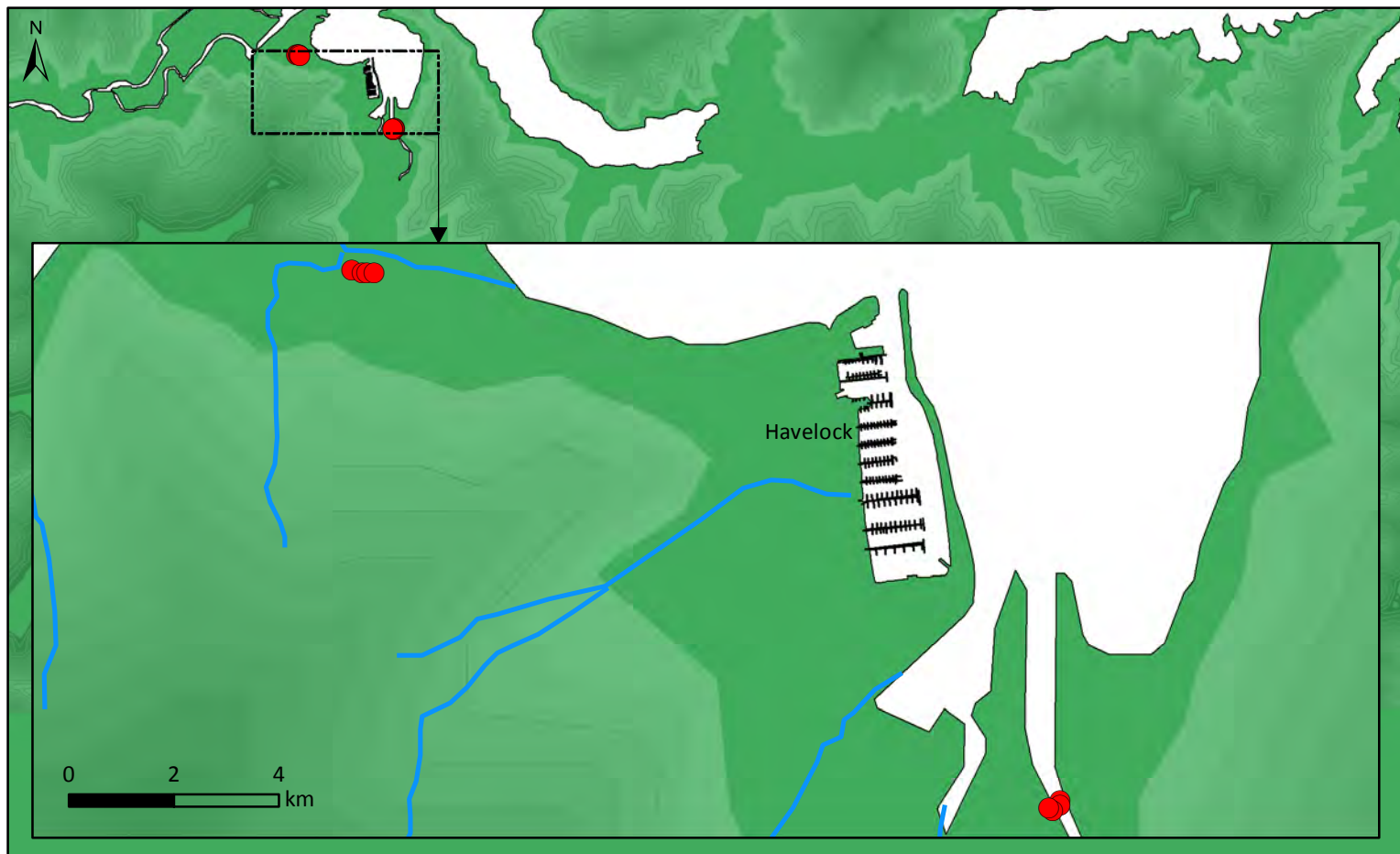
Benthic sled (BSLD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

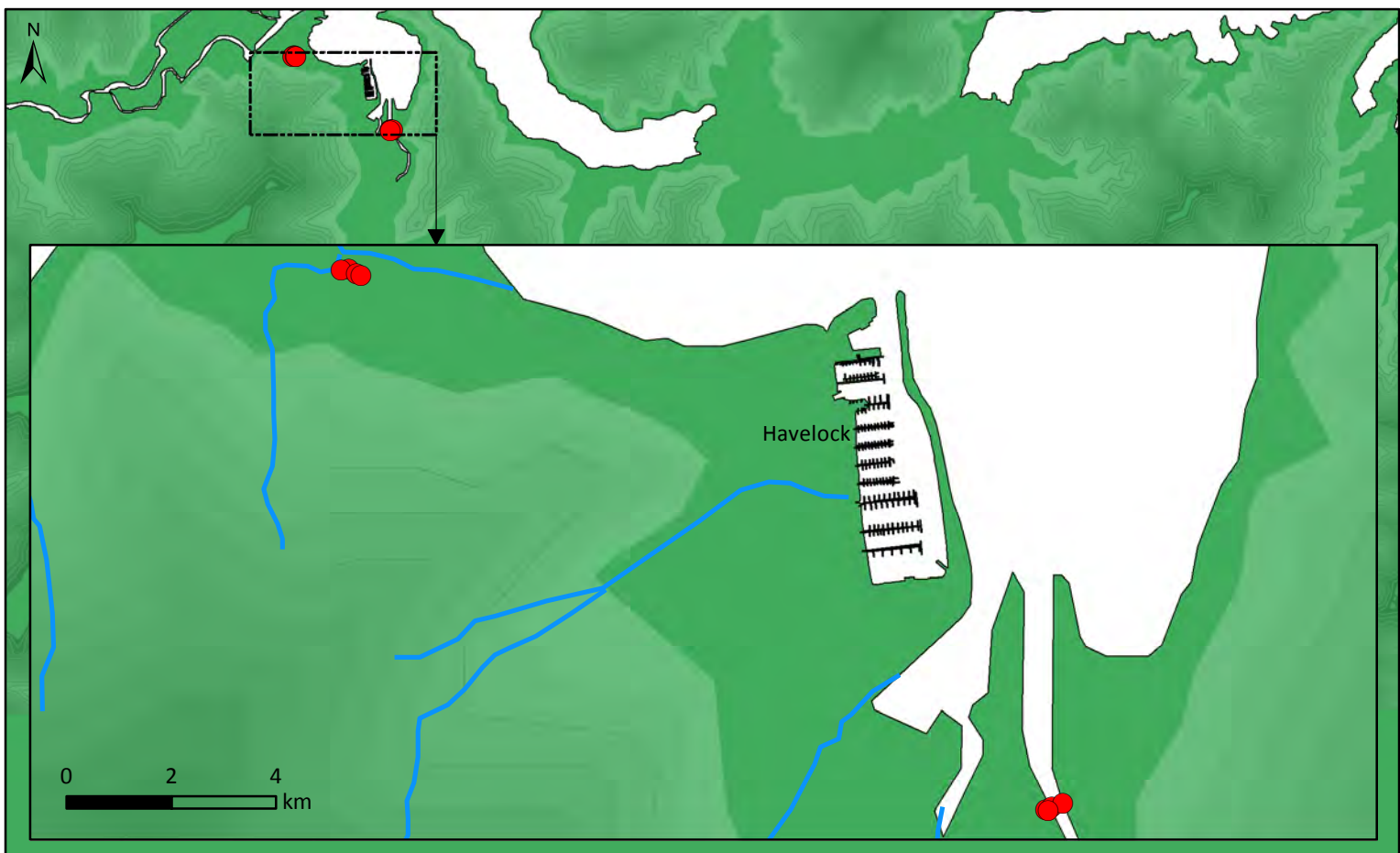
Crab condo (CONDO) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

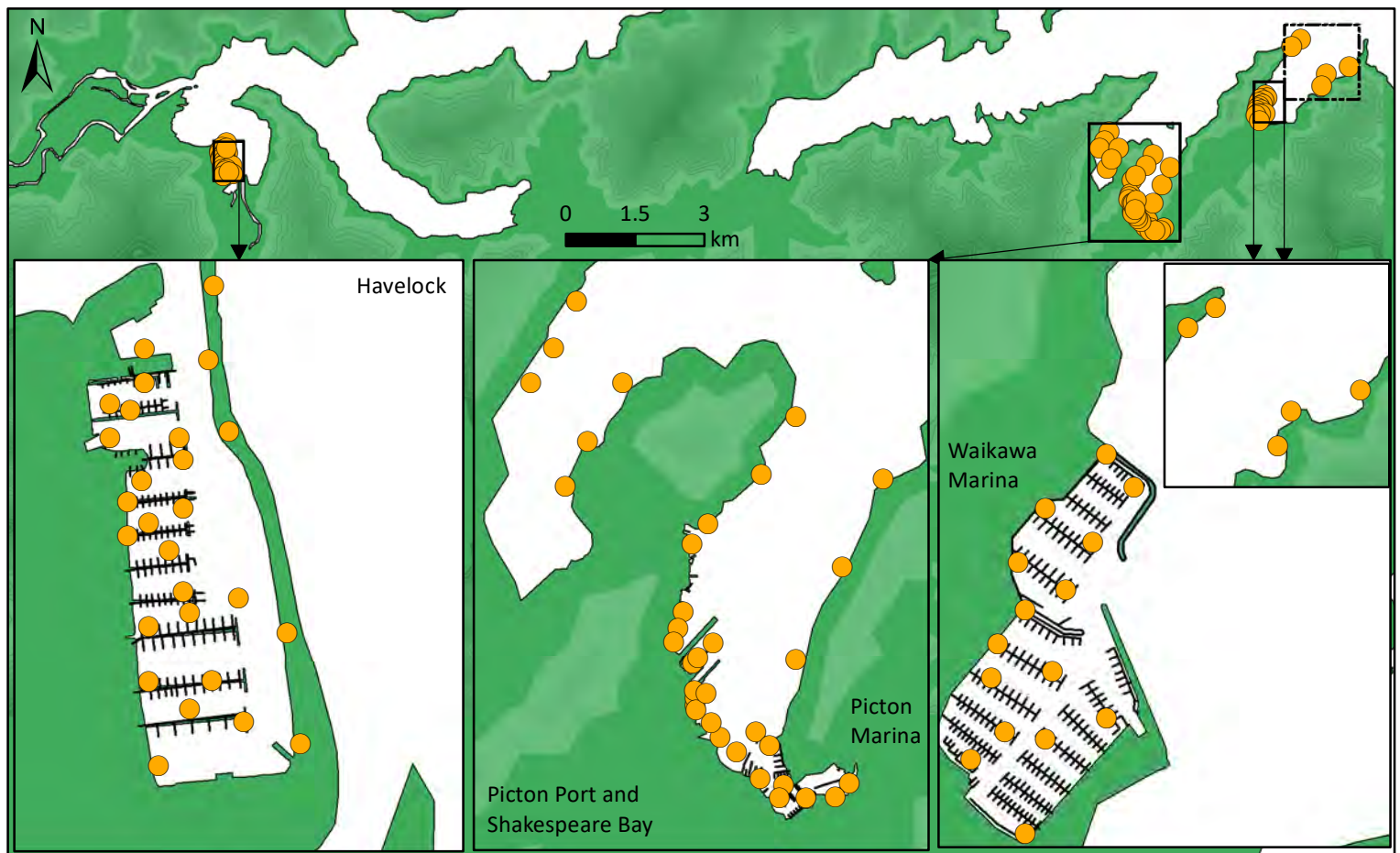
Crab condo (CONDO) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

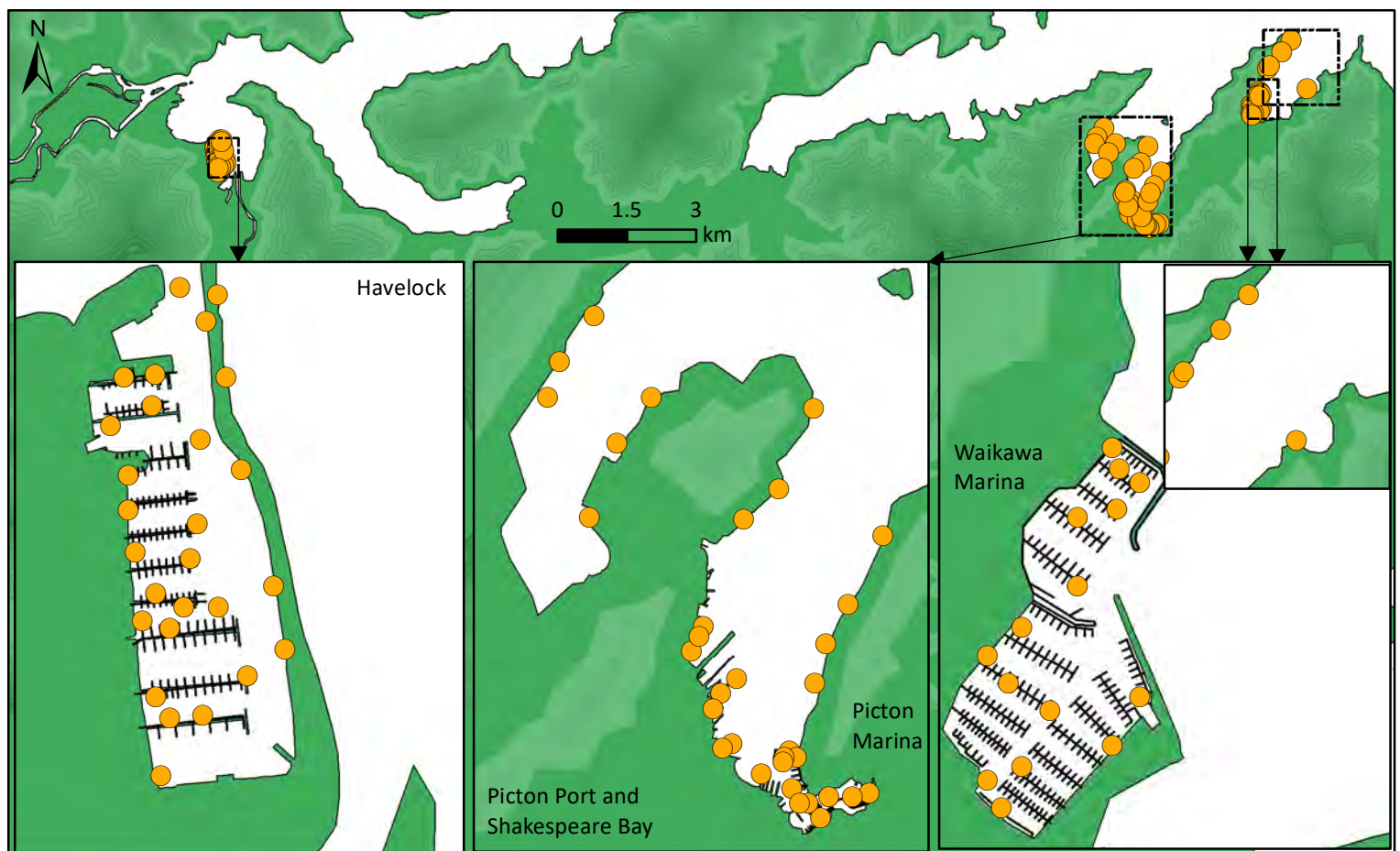
Crab trap (CRBTP) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

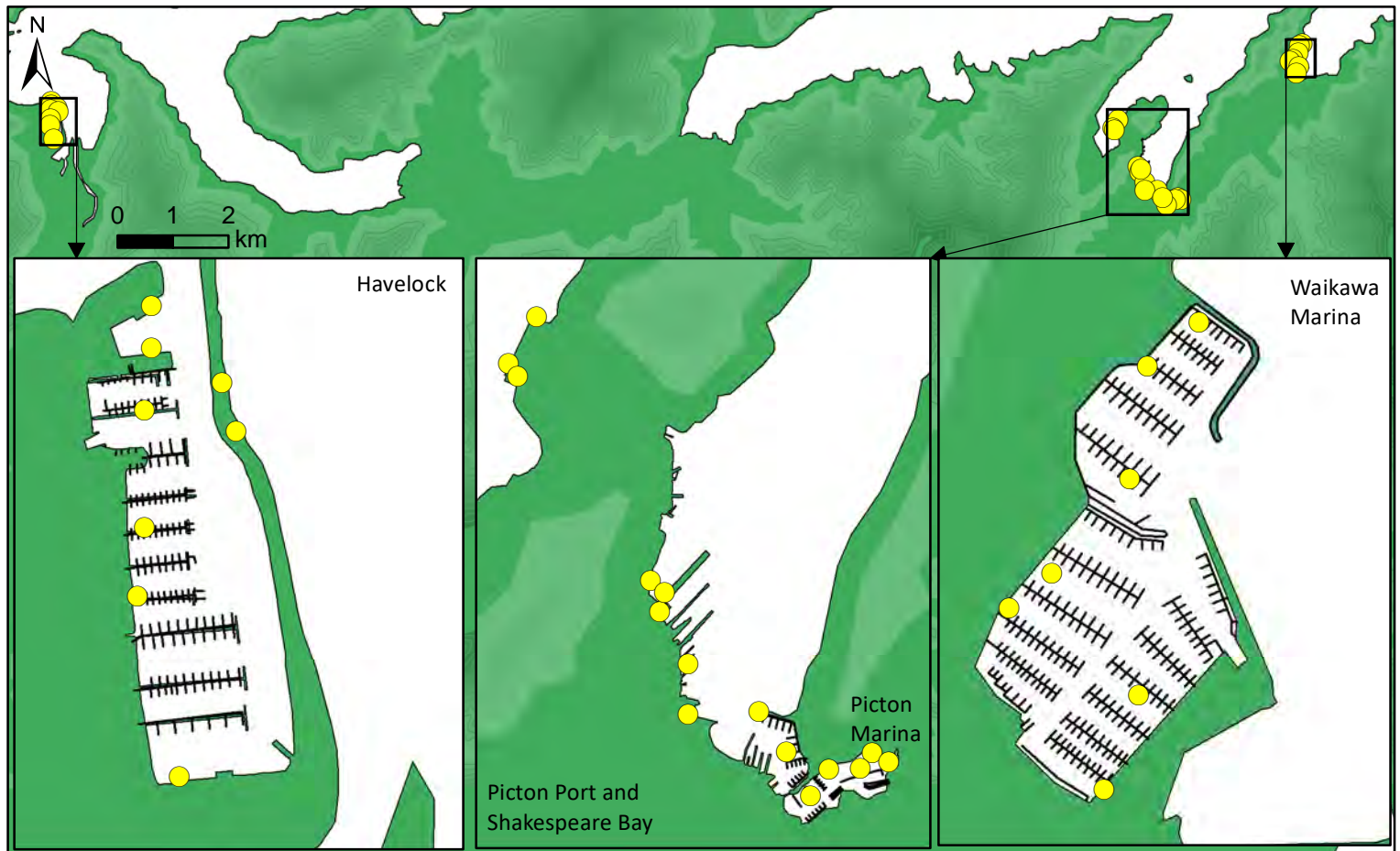
Crab trap (CRBTP) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

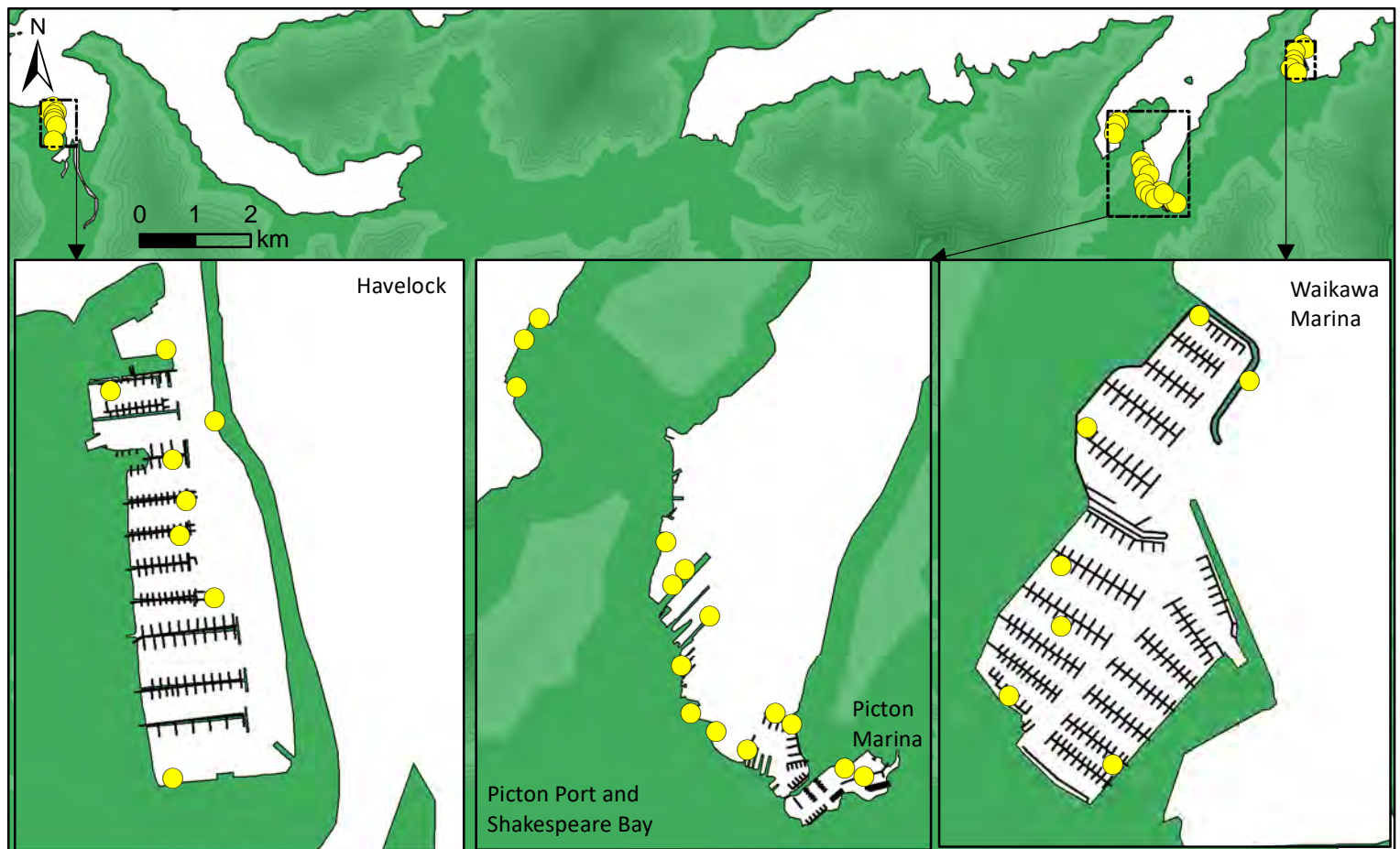
Diver search (VISD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

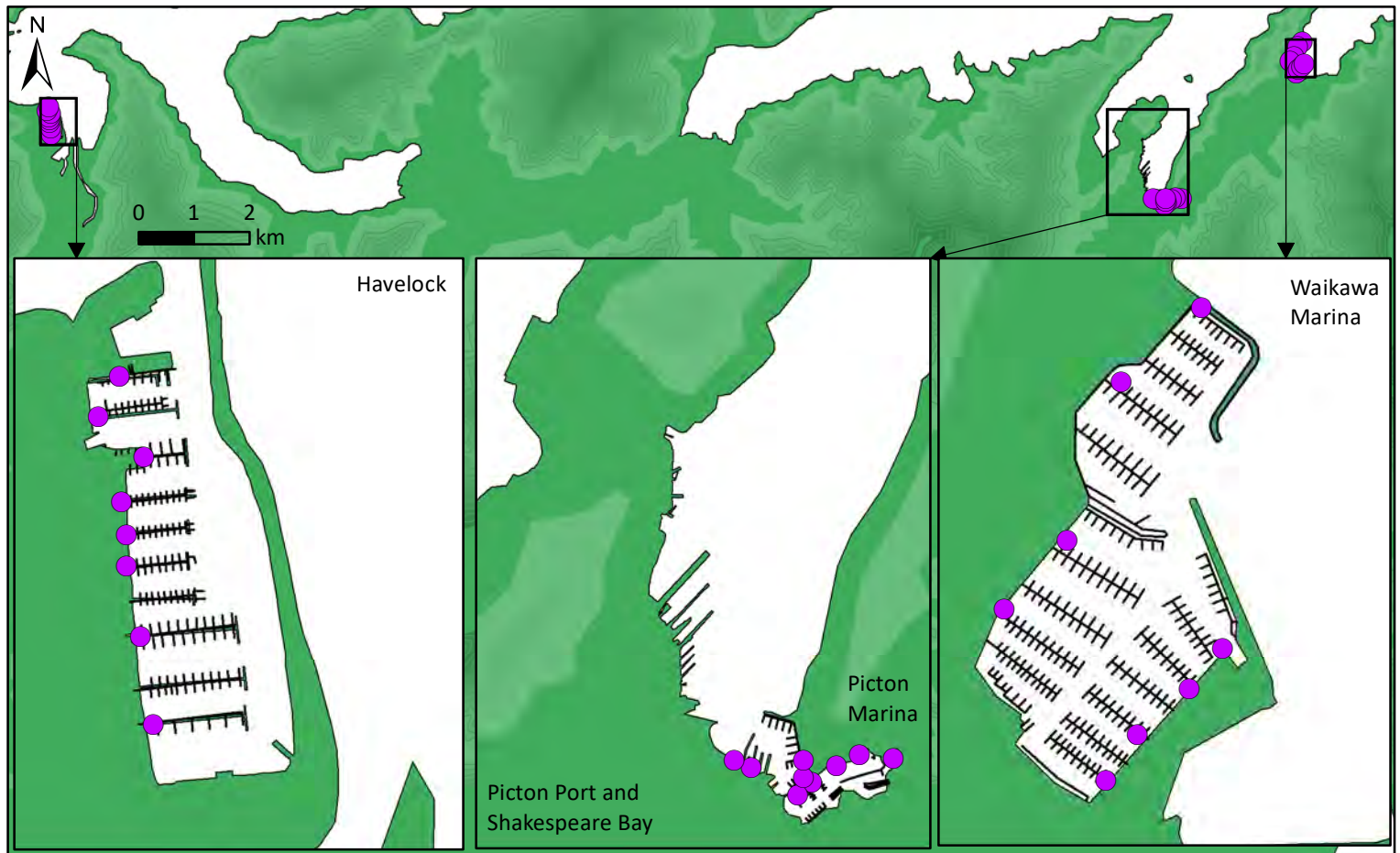
Diver search (VISD) locations



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

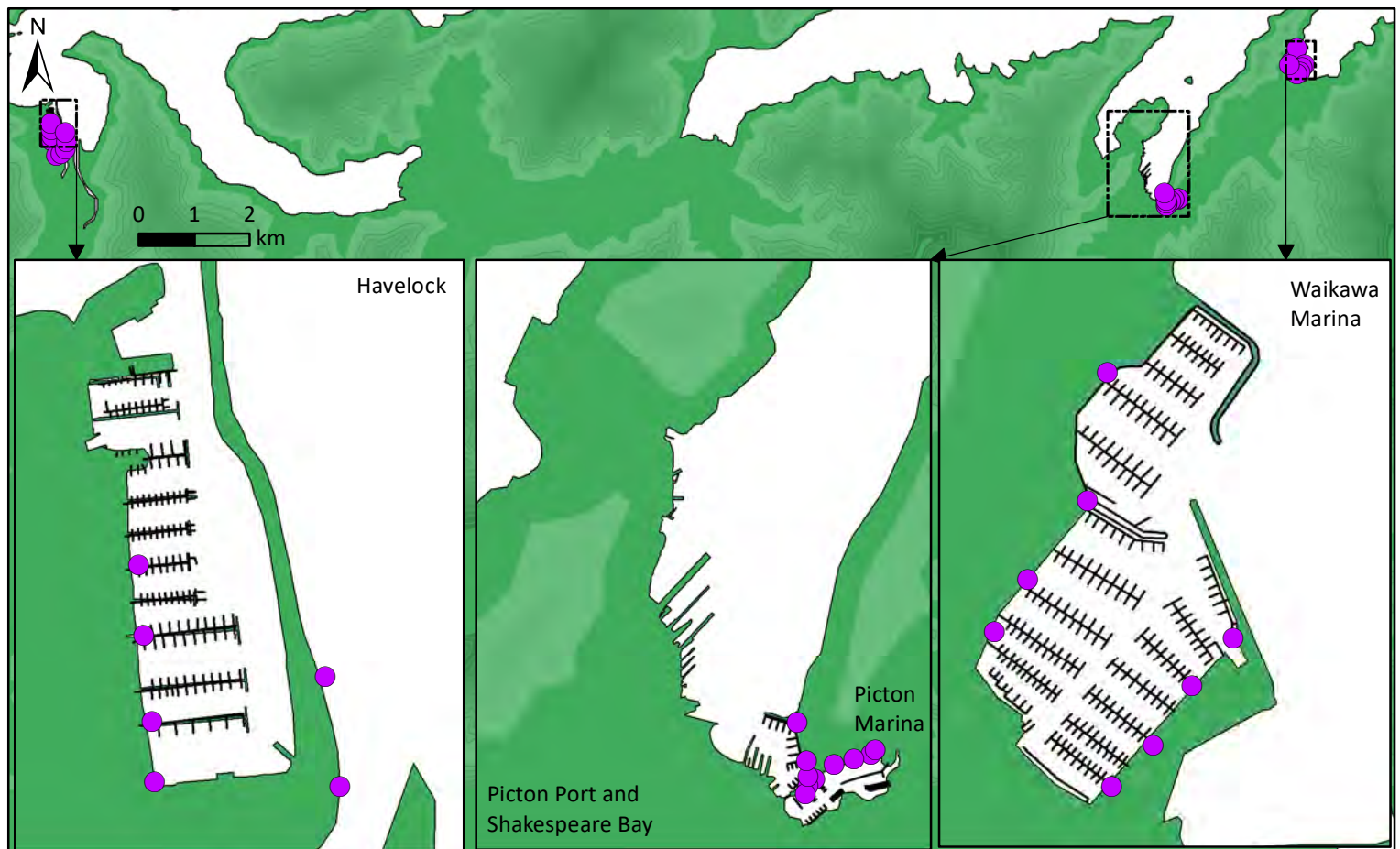
Shore search (WRACK) locations



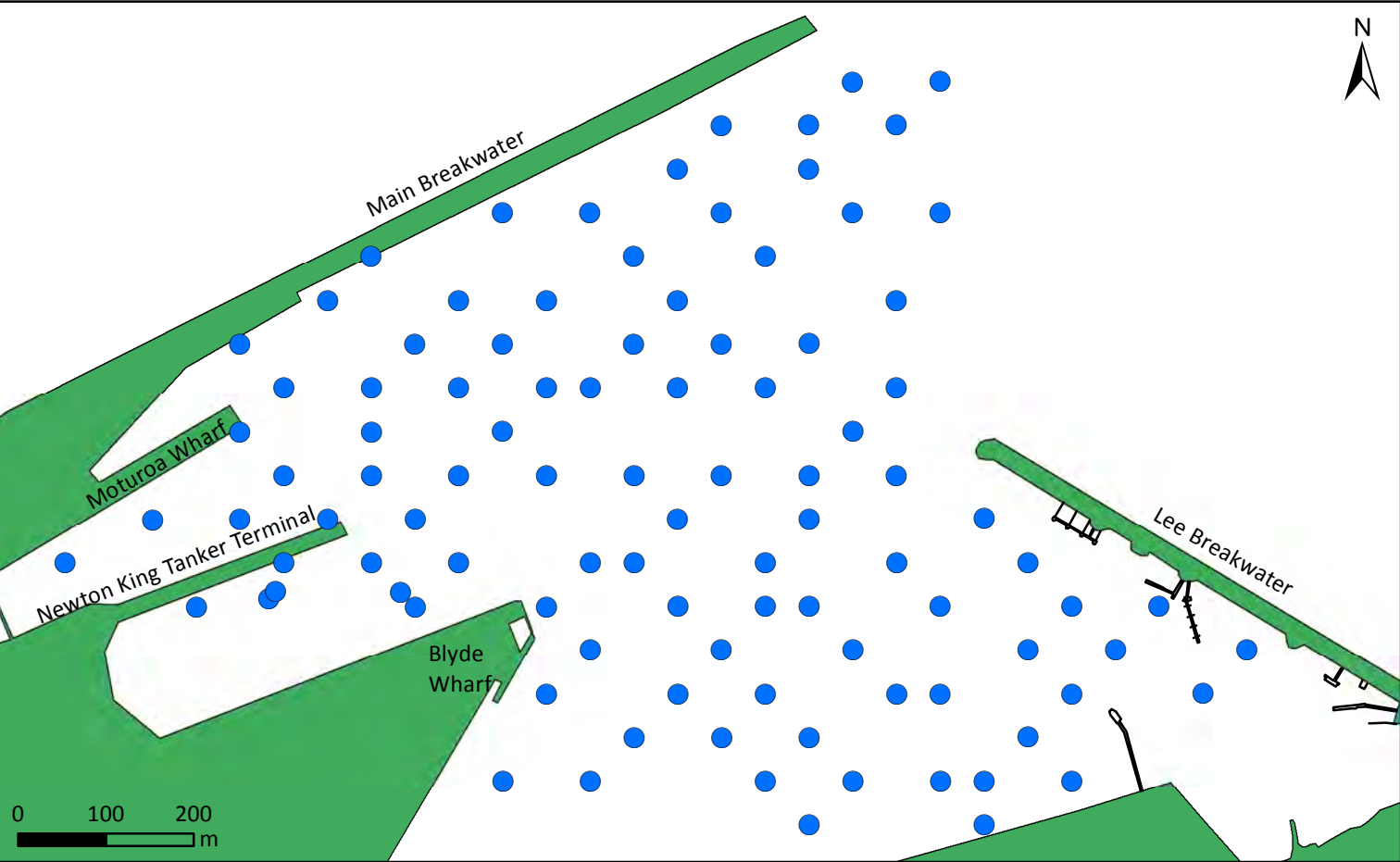
Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

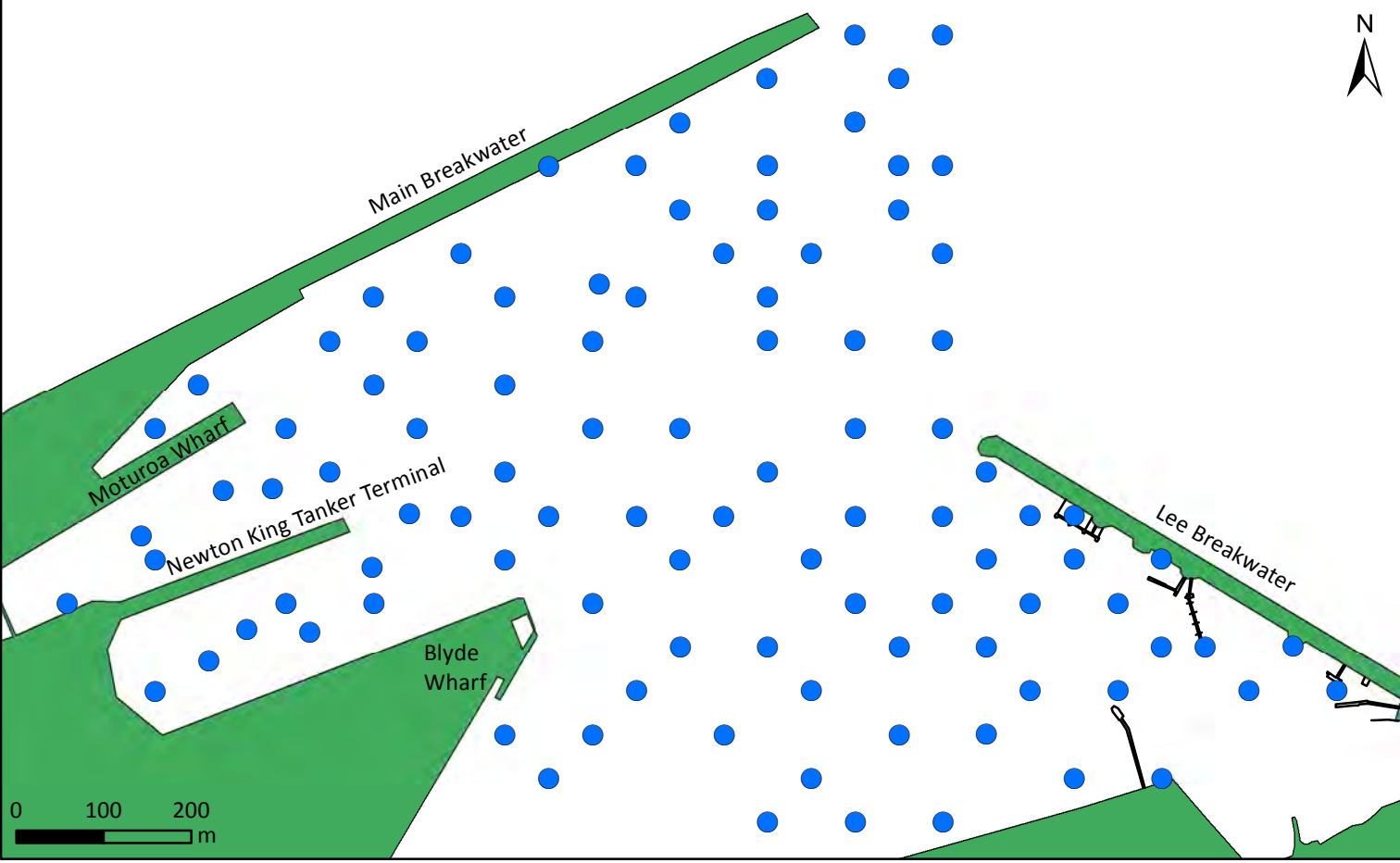
Shore search (WRACK) locations



Port Taranaki
Winter 2017
Benthic sled (BSLD) locations



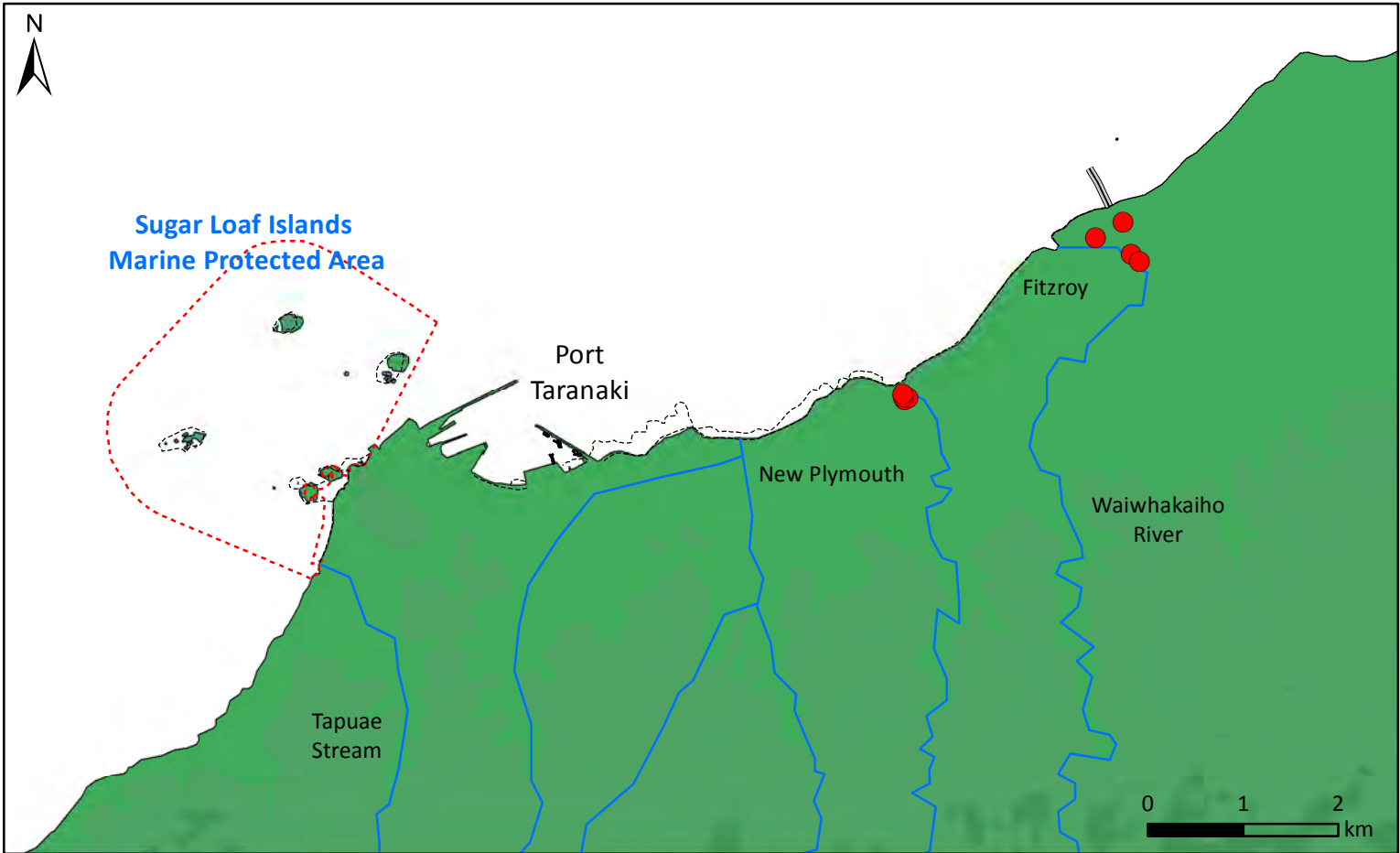
Port Taranaki
Summer 2017-18
Benthic sled (BSLD) locations



Port Taranaki

Winter 2017

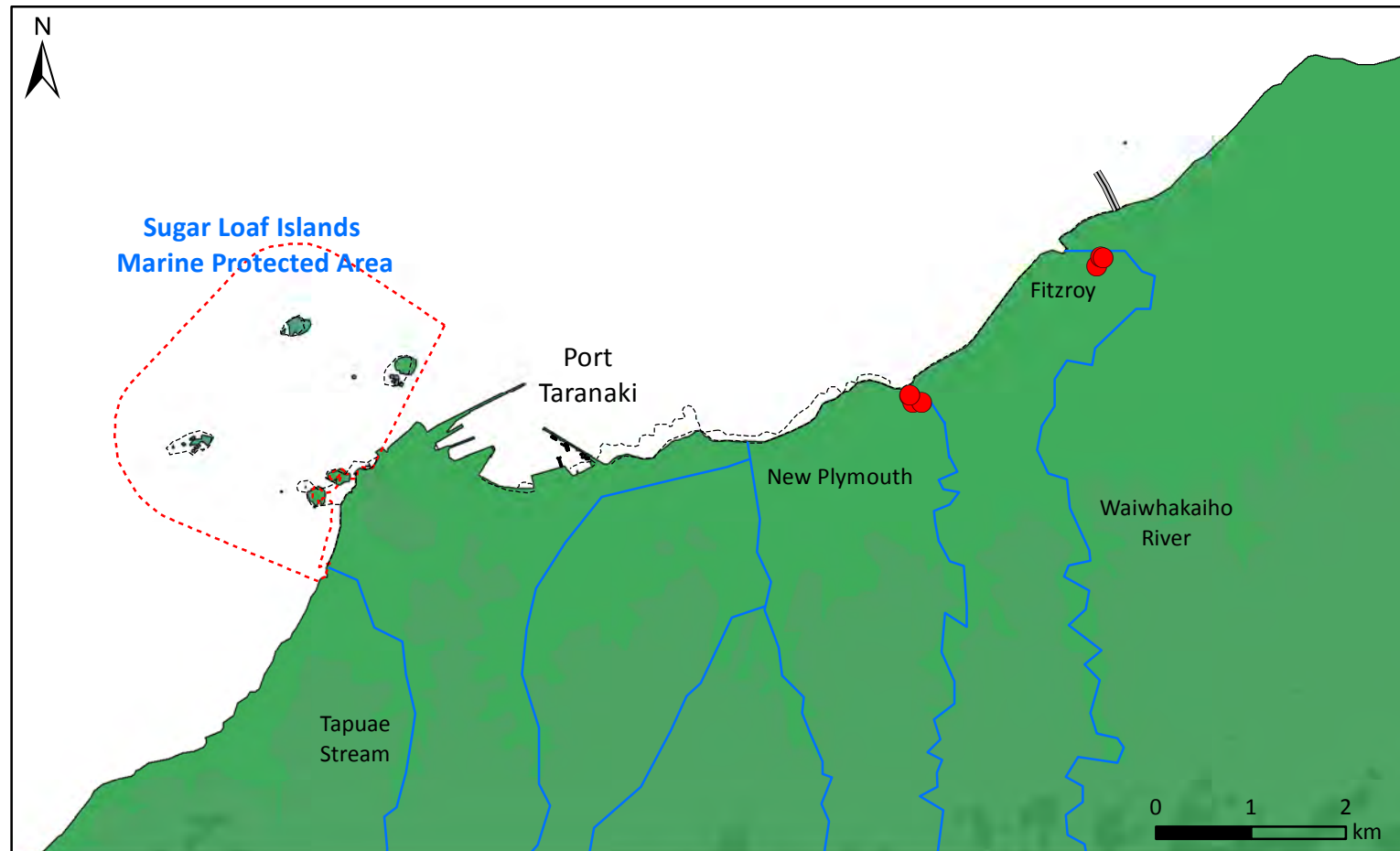
Crab condo (CONDO) locations



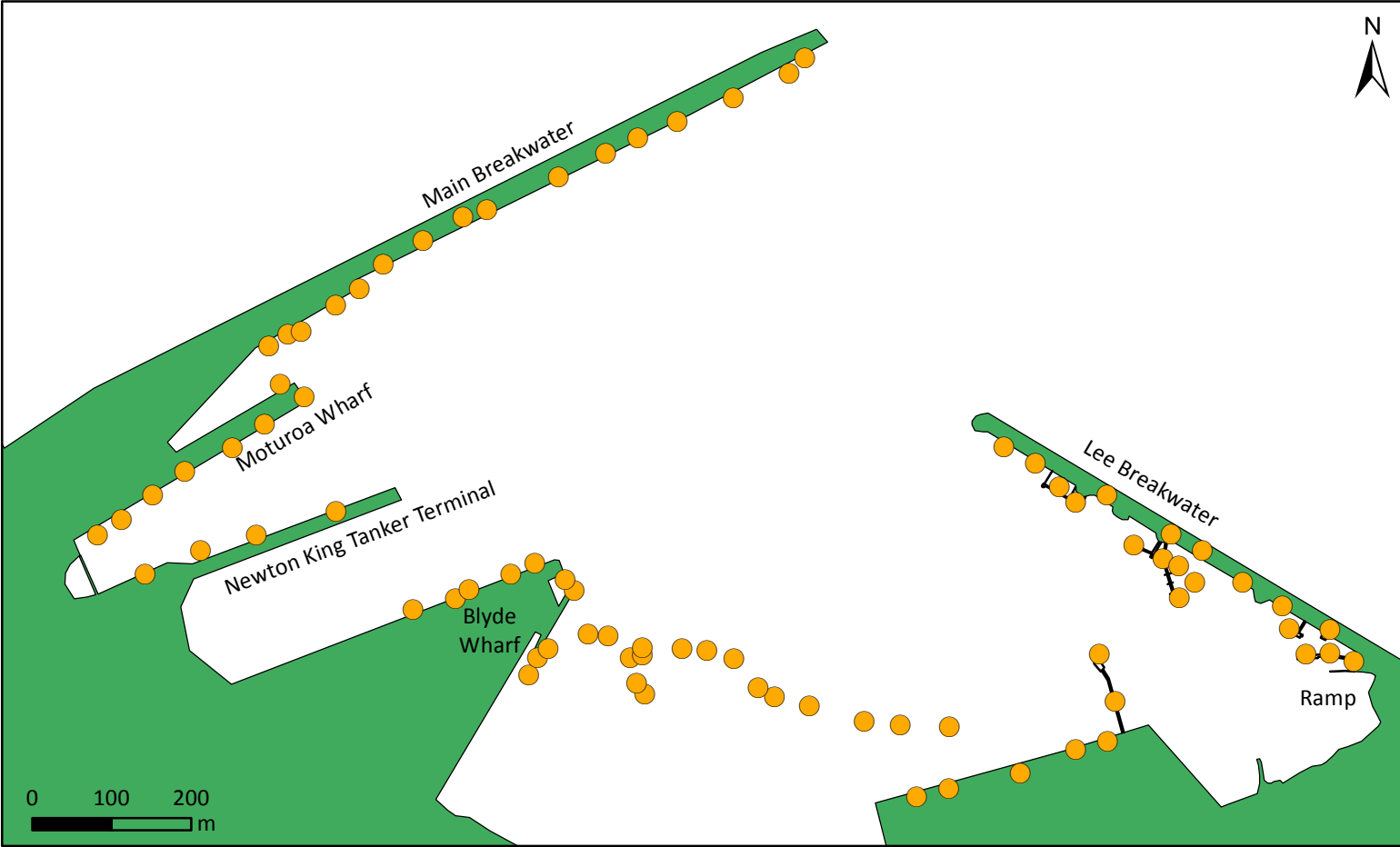
Port Taranaki

Summer 2017-18

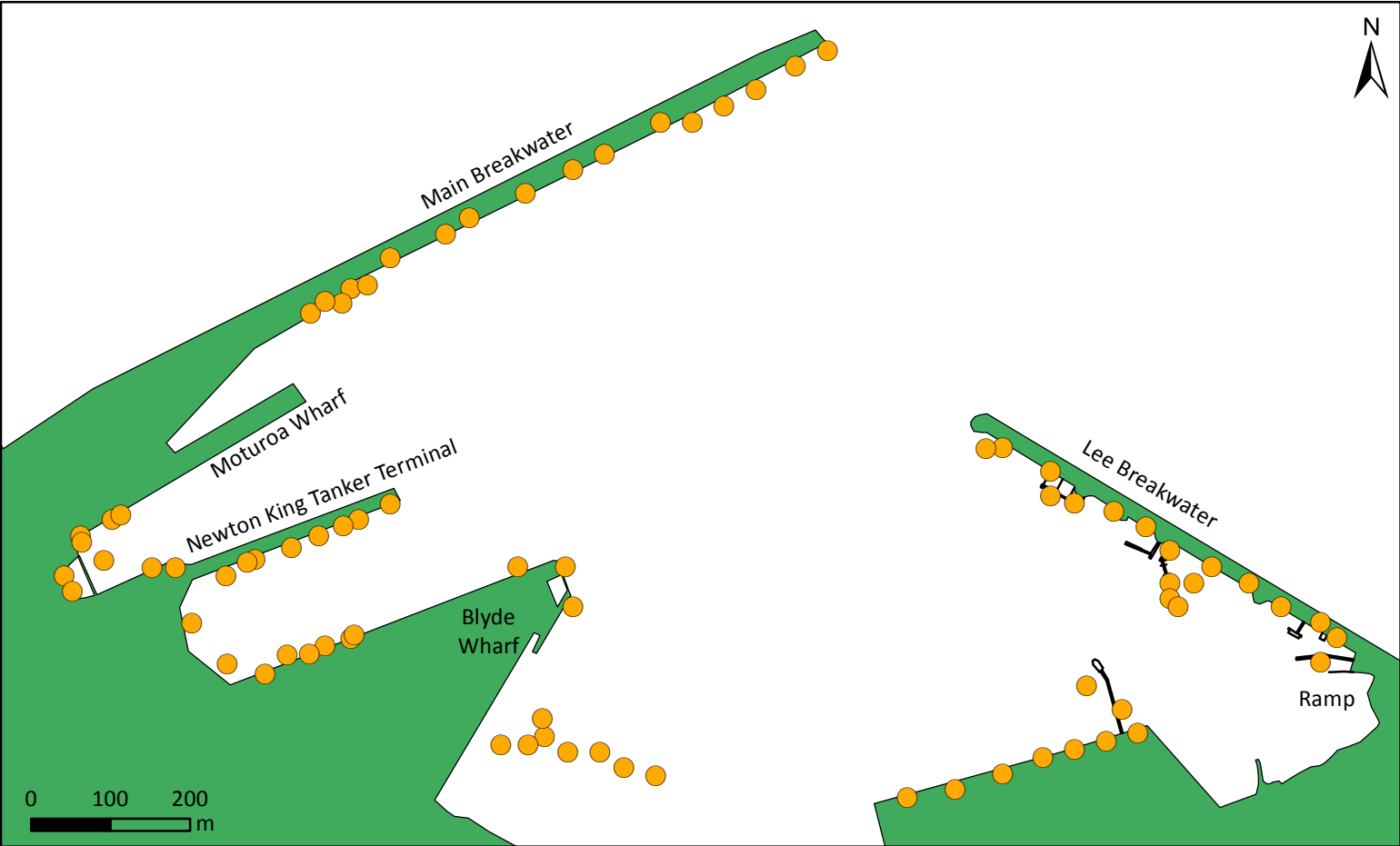
Crab condo (CONDO) locations



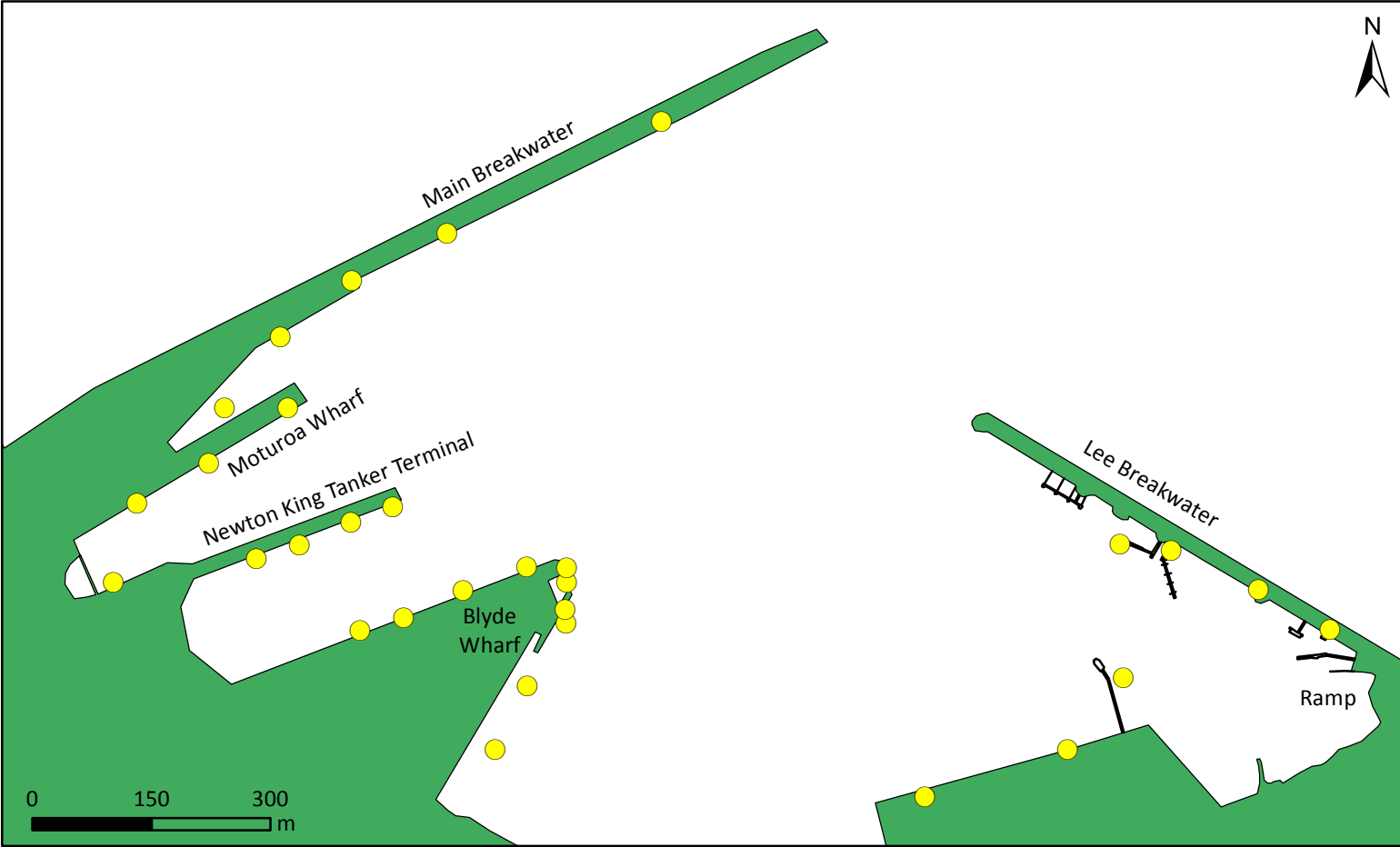
Port Taranaki
Winter 2017
Crab trap (CRBTP) locations



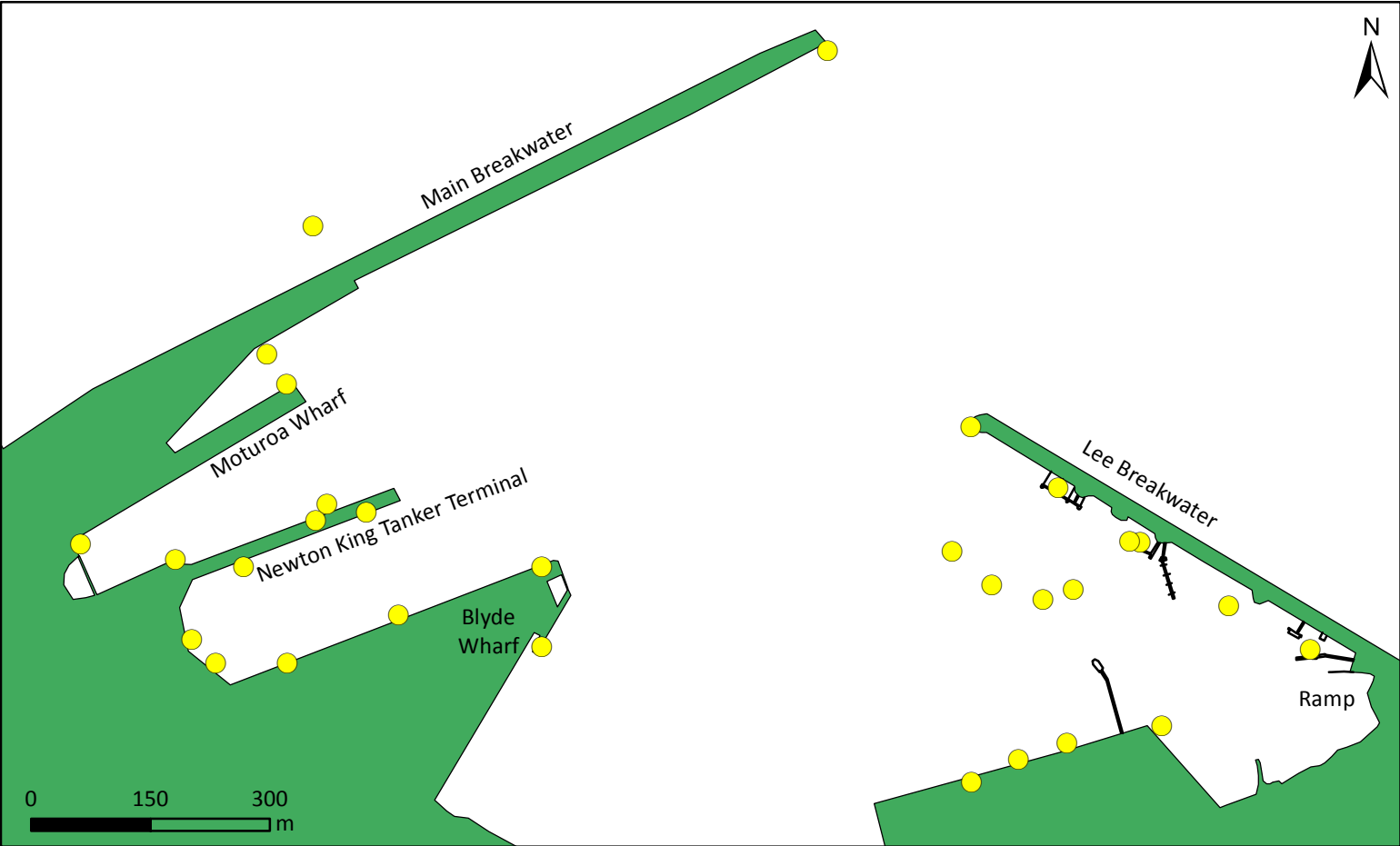
Port Taranaki
Summer 2017-18
Crab trap (CRBTP) locations



Port Taranaki
Winter 2017
Diver search (VISD) locations



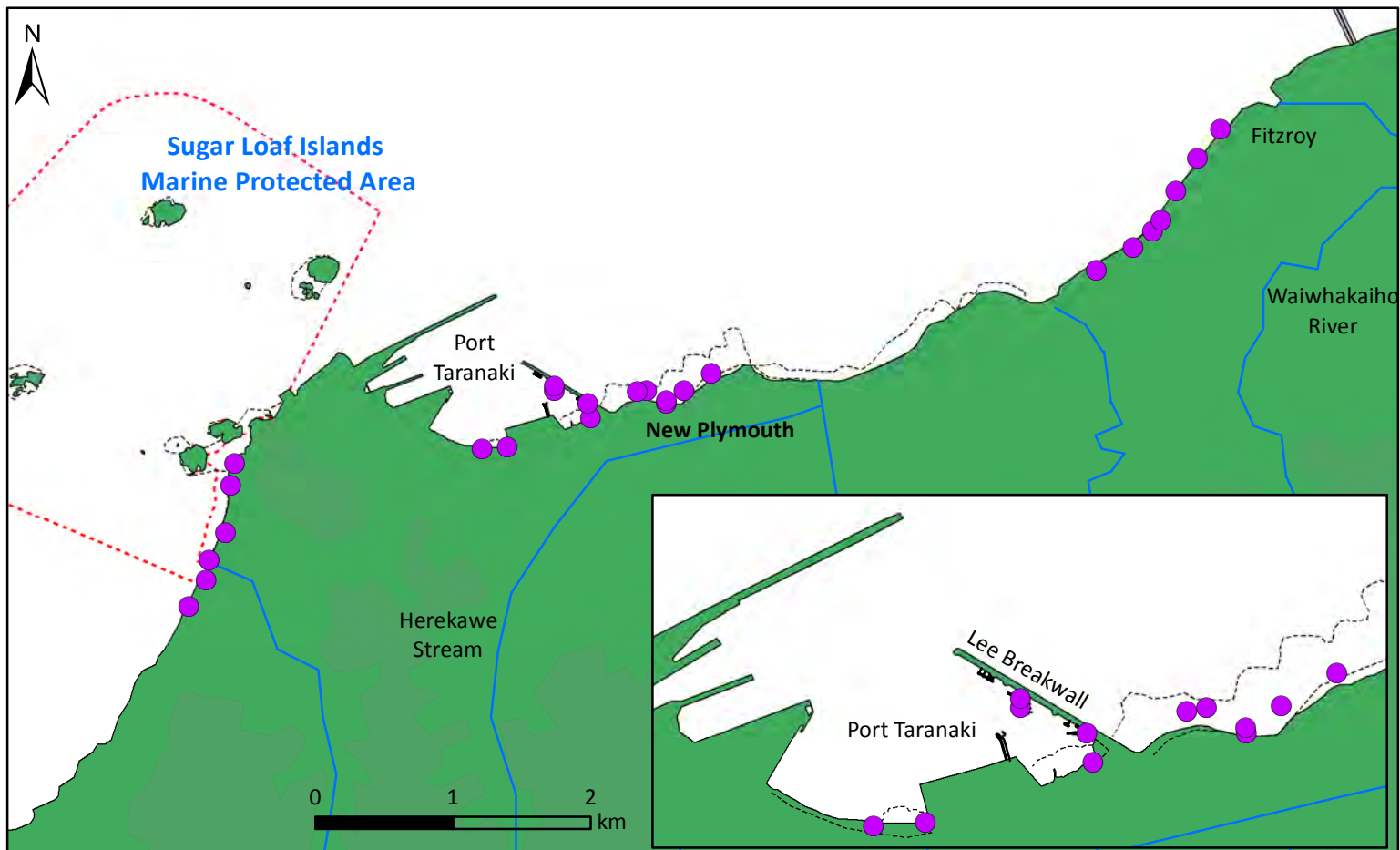
Port Taranaki
Summer 2017-18
Diver search (VISD) locations



Port Taranaki

Winter 2017

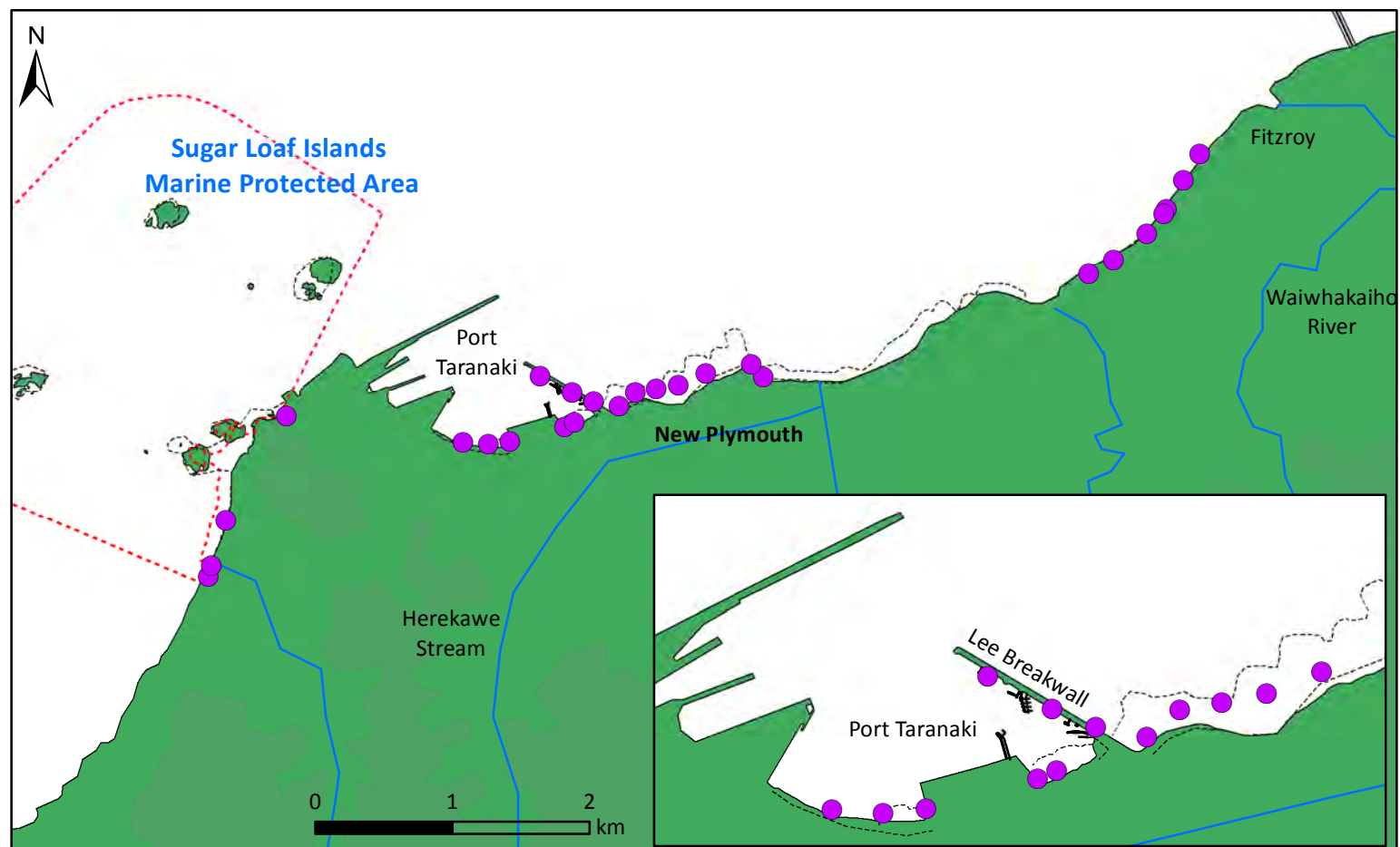
Shore search (WRACK) locations



Port Taranaki

Summer 2017-18

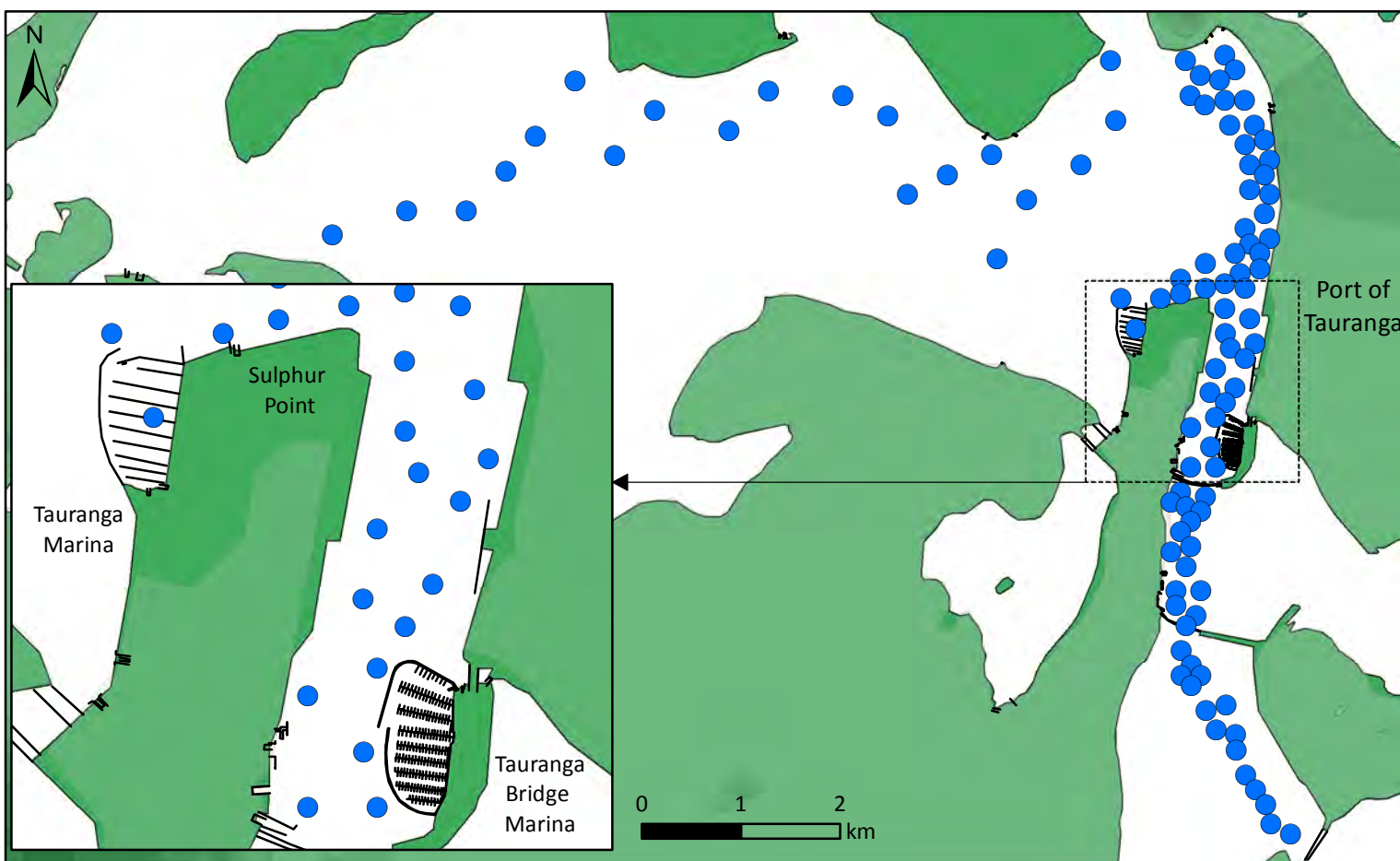
Shore search (WRACK) locations



Tauranga Harbour

Winter 2017

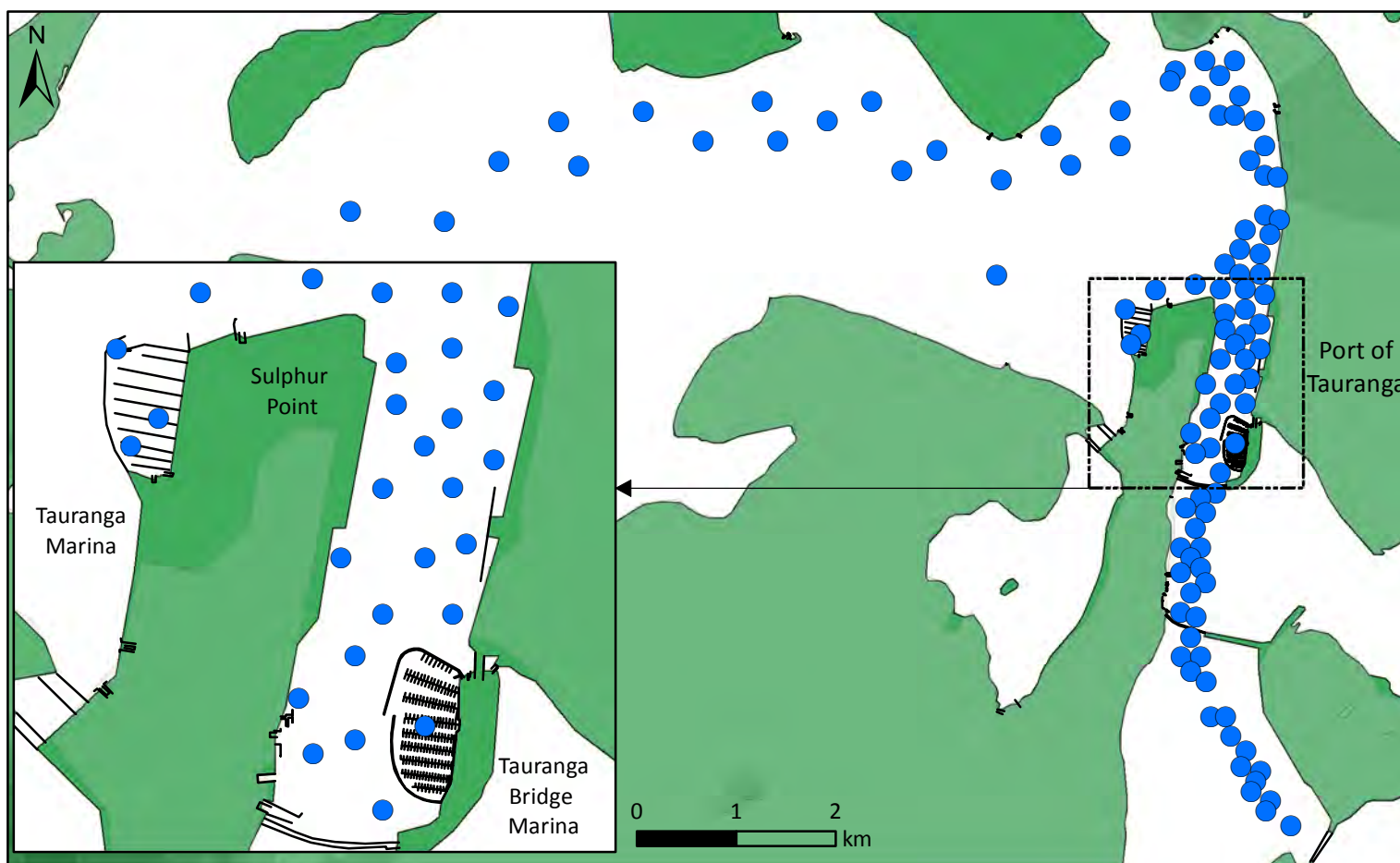
Benthic sled (BSLD) locations



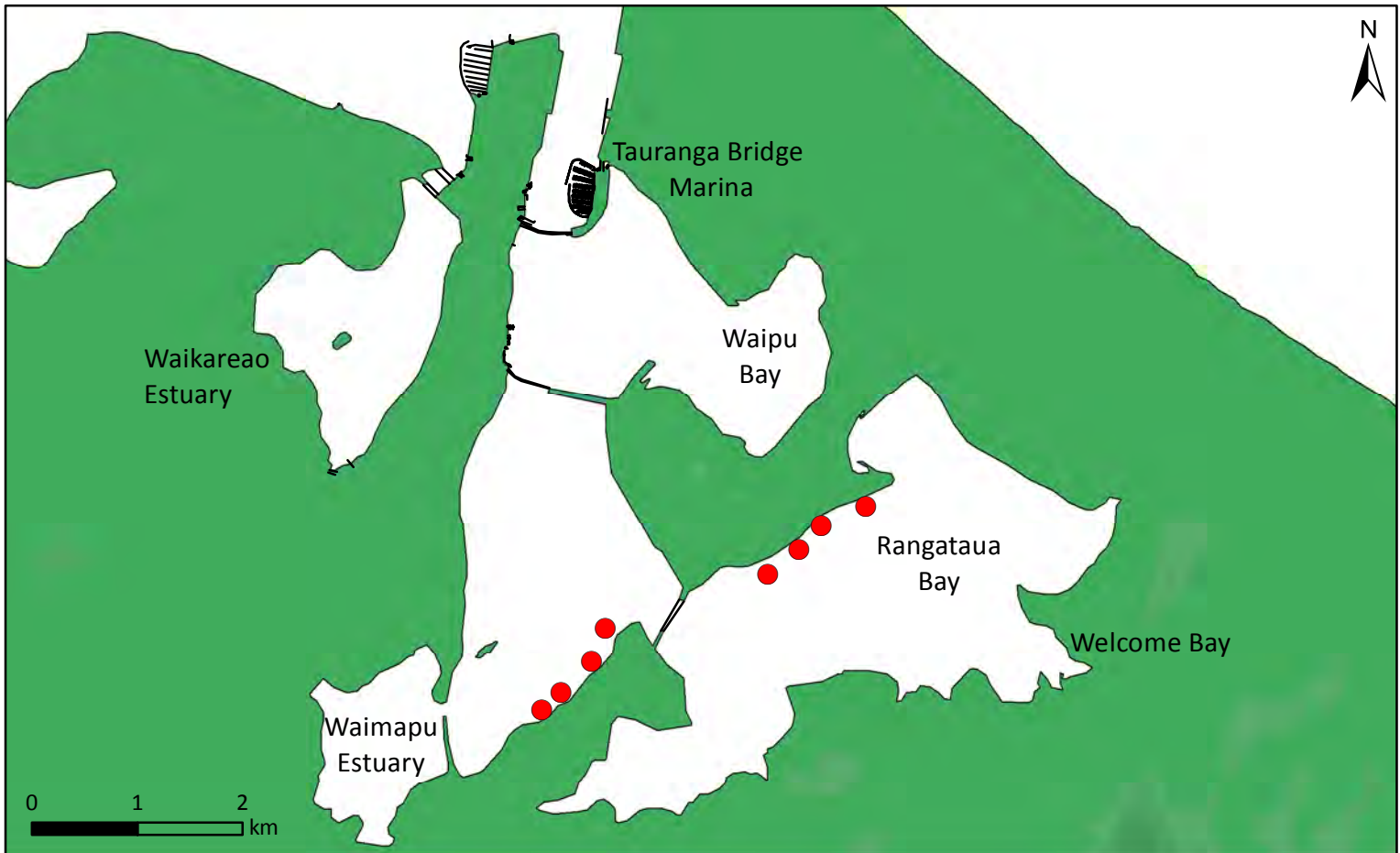
Tauranga Harbour

Summer 2017-18

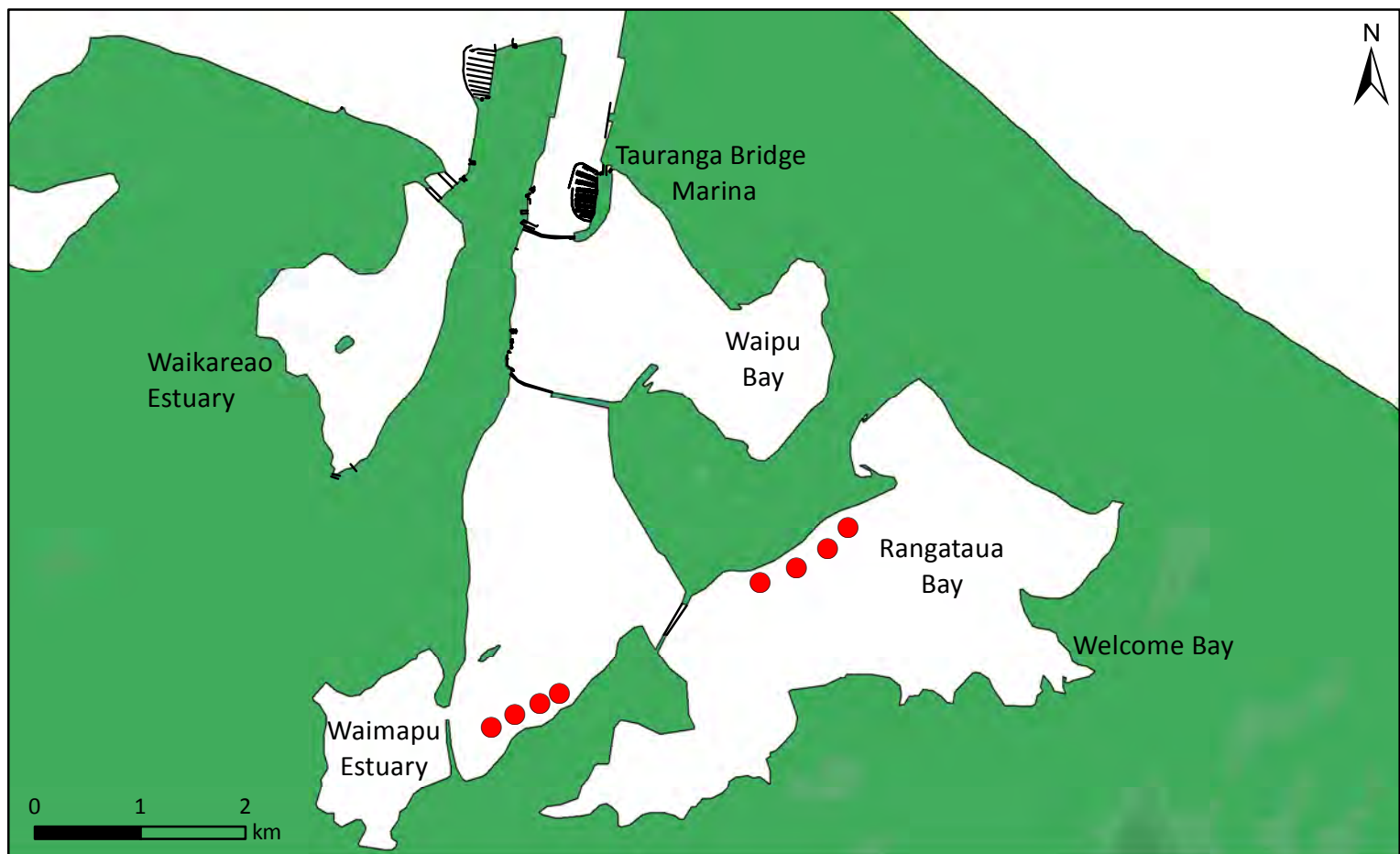
Benthic sled (BSLD) locations



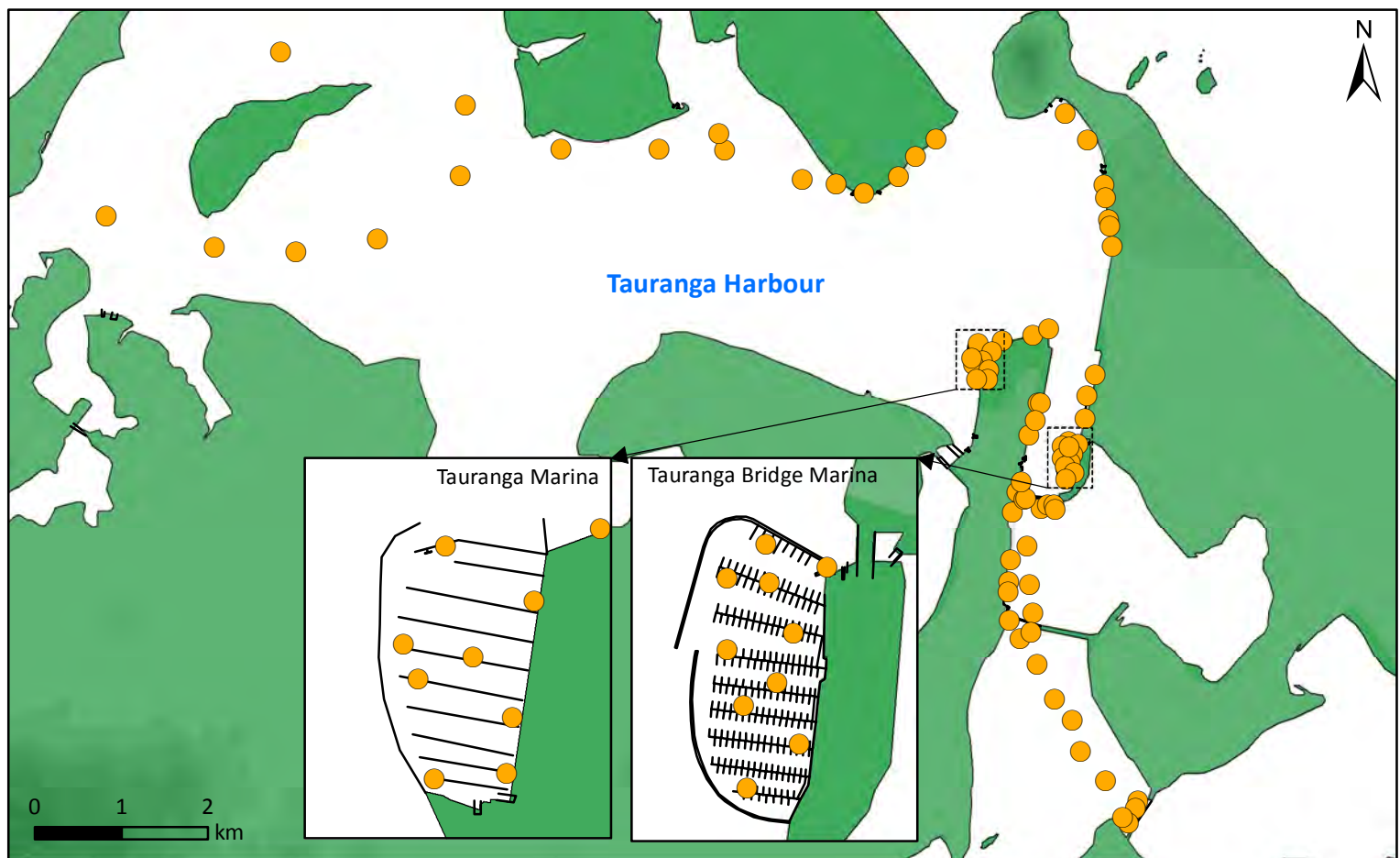
Tauranga Harbour
Winter 2017
Crab condo (CONDO) locations



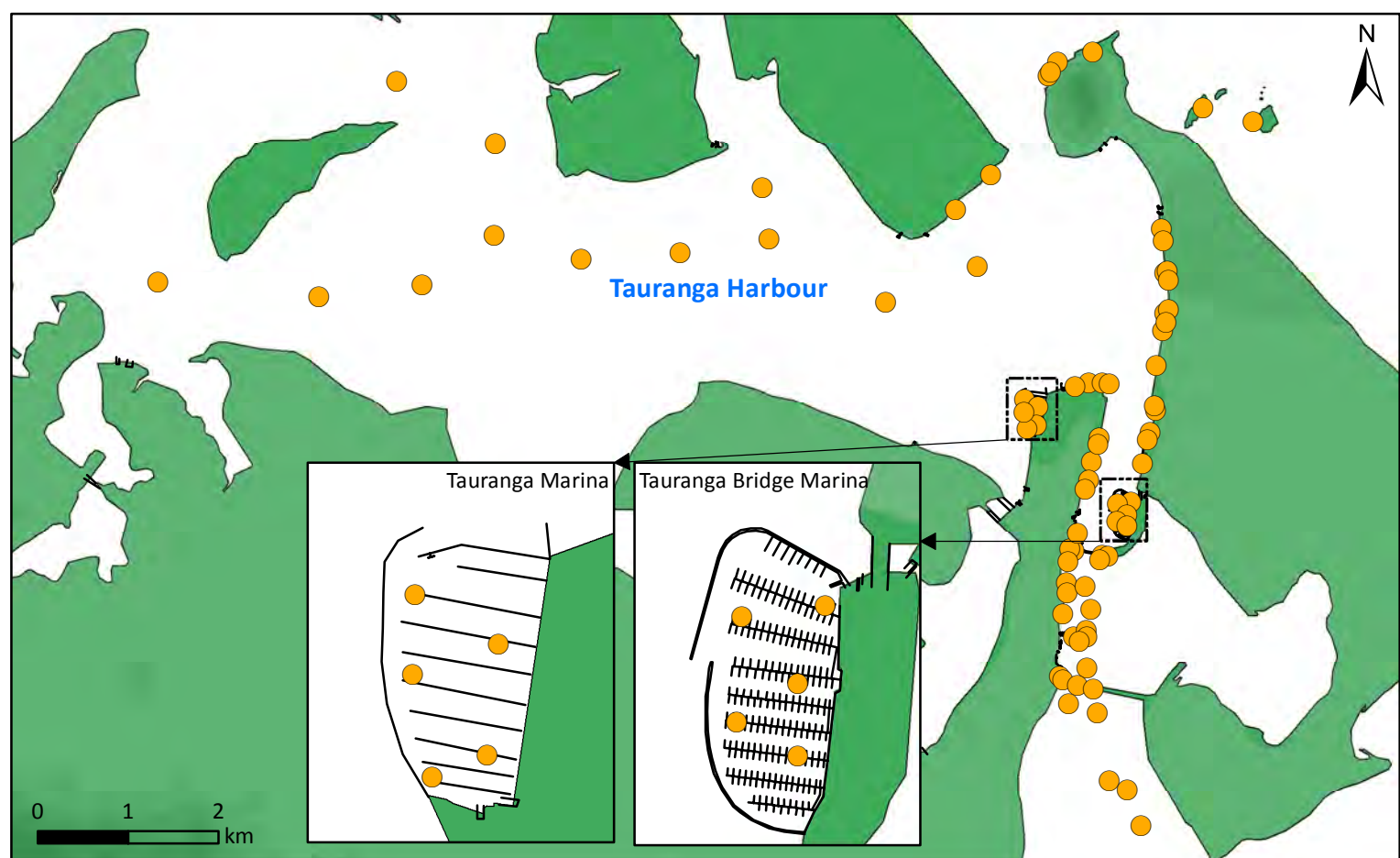
Tauranga Harbour
Summer 2017-18
Crab condo (CONDO) locations



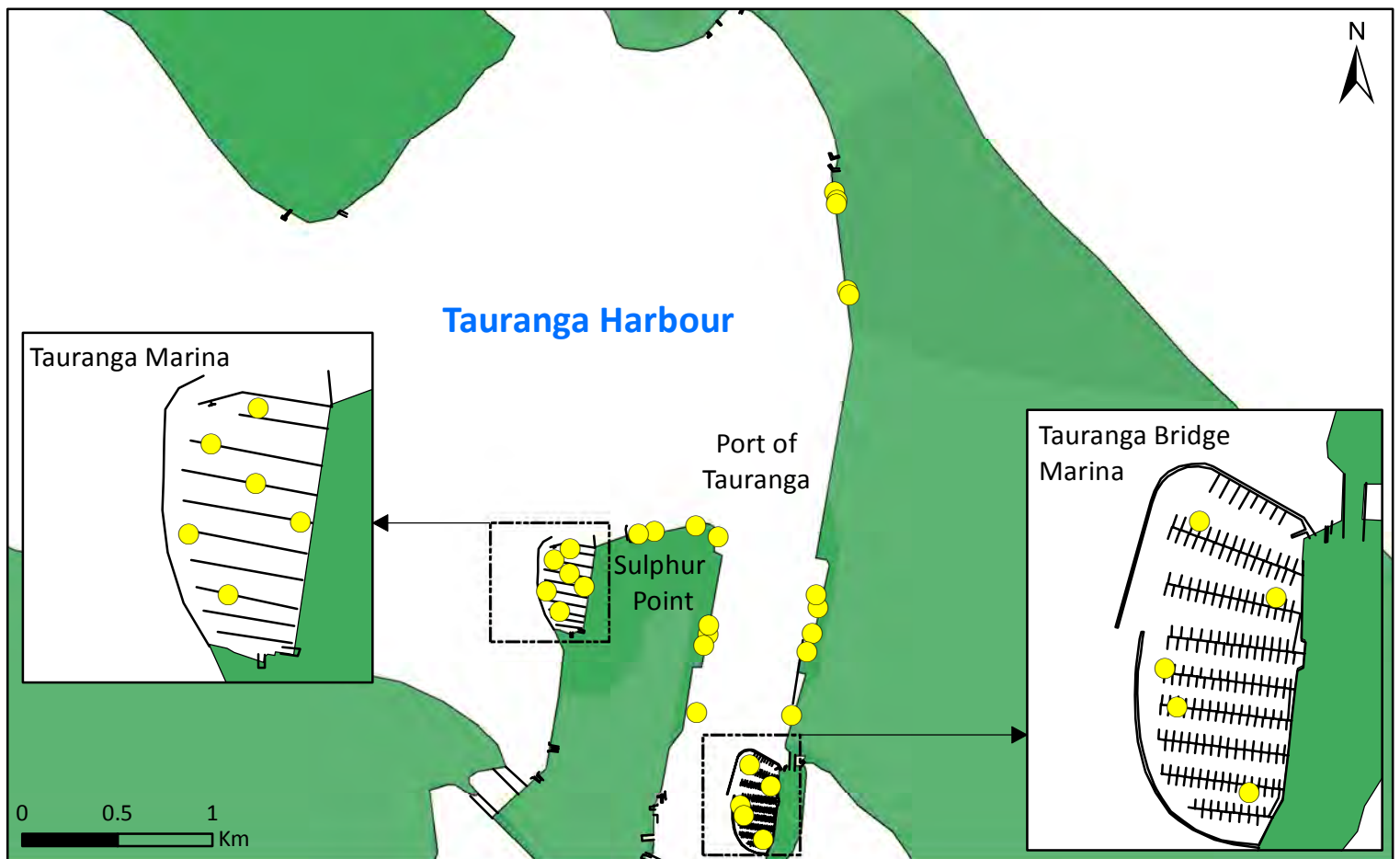
Tauranga Harbour
Winter 2017
Crab trap (CRBTP) locations



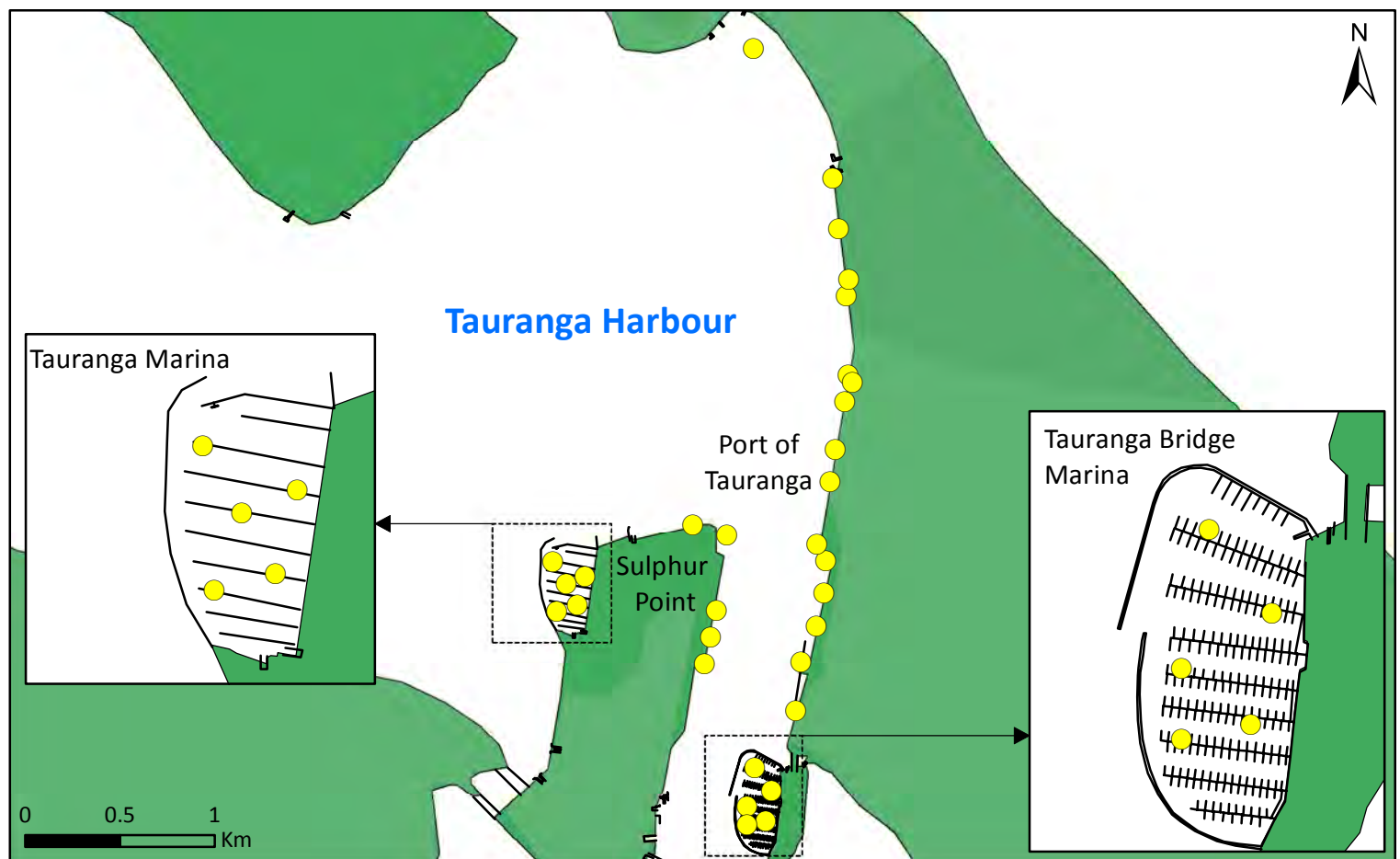
Tauranga Harbour
Summer 2017-18
Crab trap (CRBTP) locations



Tauranga Harbour
Winter 2017
Diver search (VISD) locations



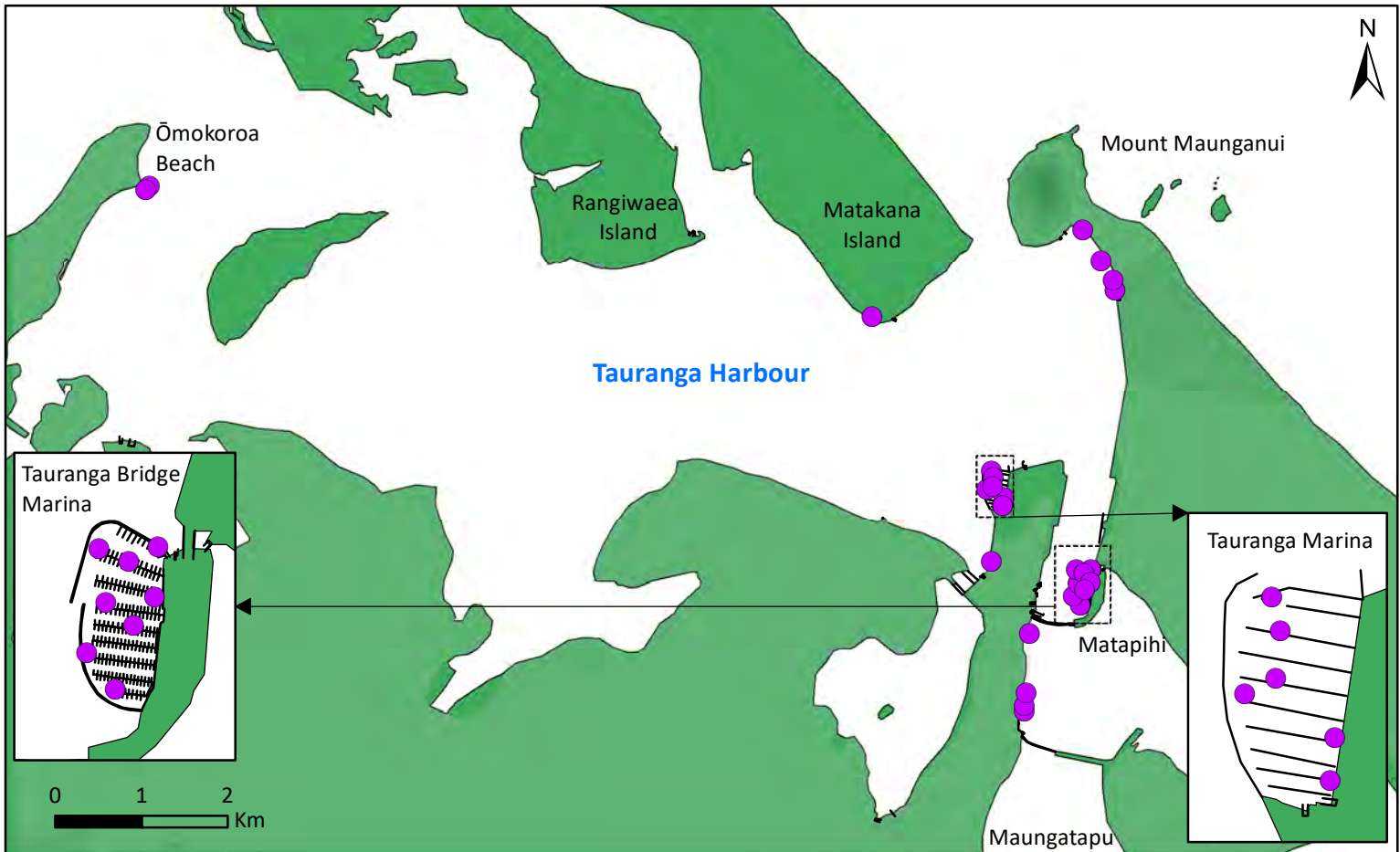
Tauranga Harbour
Summer 2017-18
Diver search (VISD) locations



Tauranga Harbour

Winter 2017

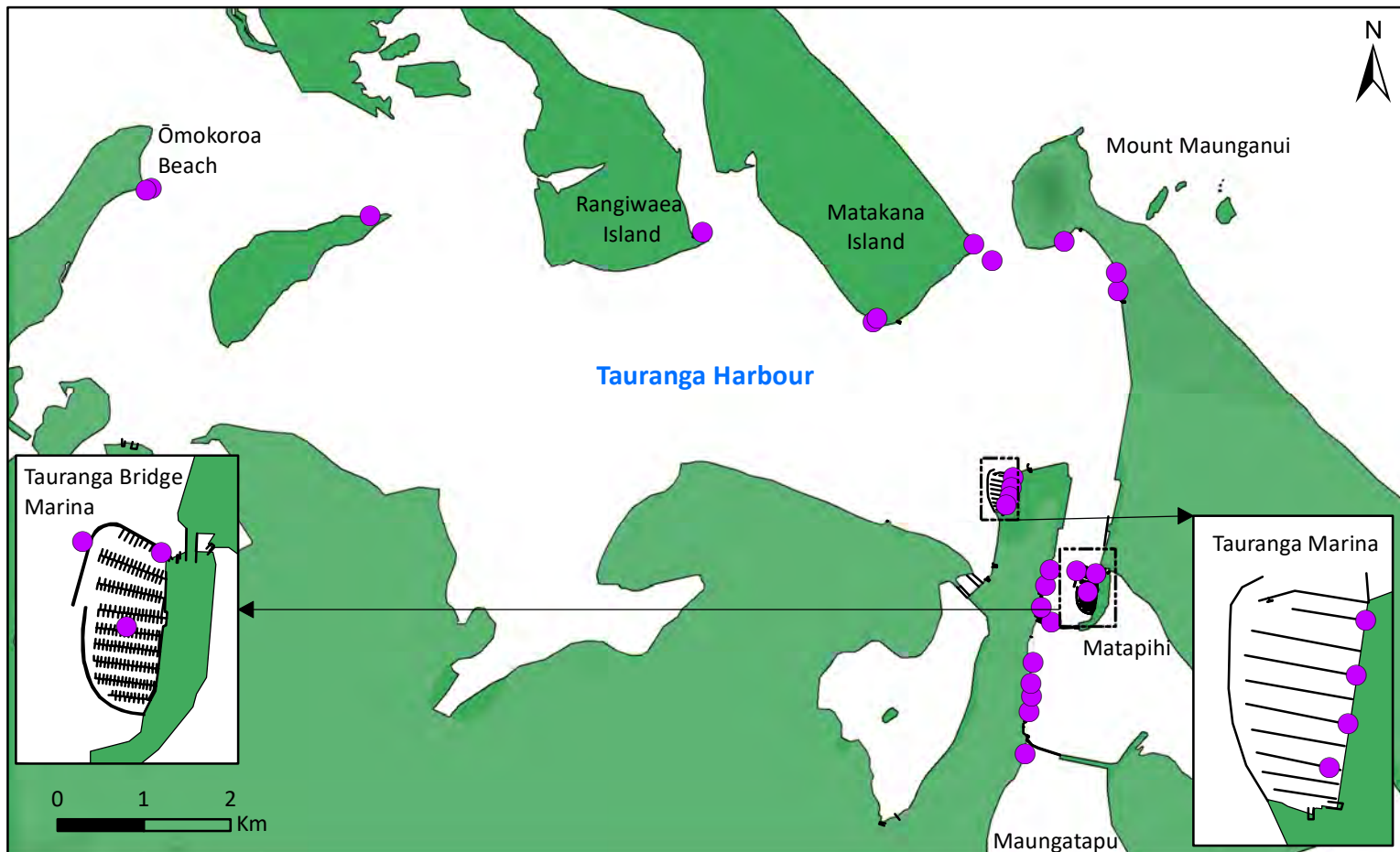
Shore search (WRACK) locations



Tauranga Harbour

Summer 2017-18

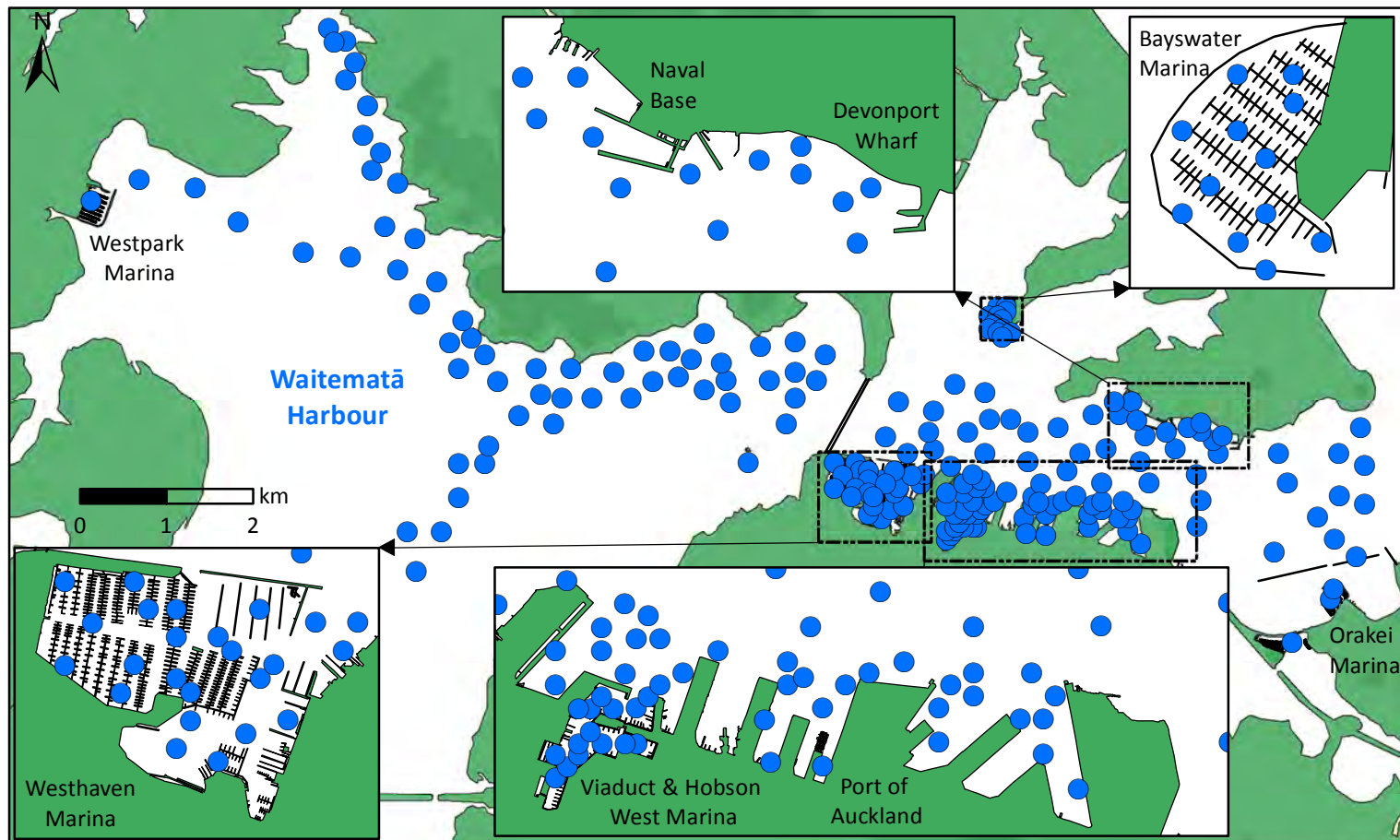
Shore search (WRACK) locations



Waitematā Harbour

Winter 2017

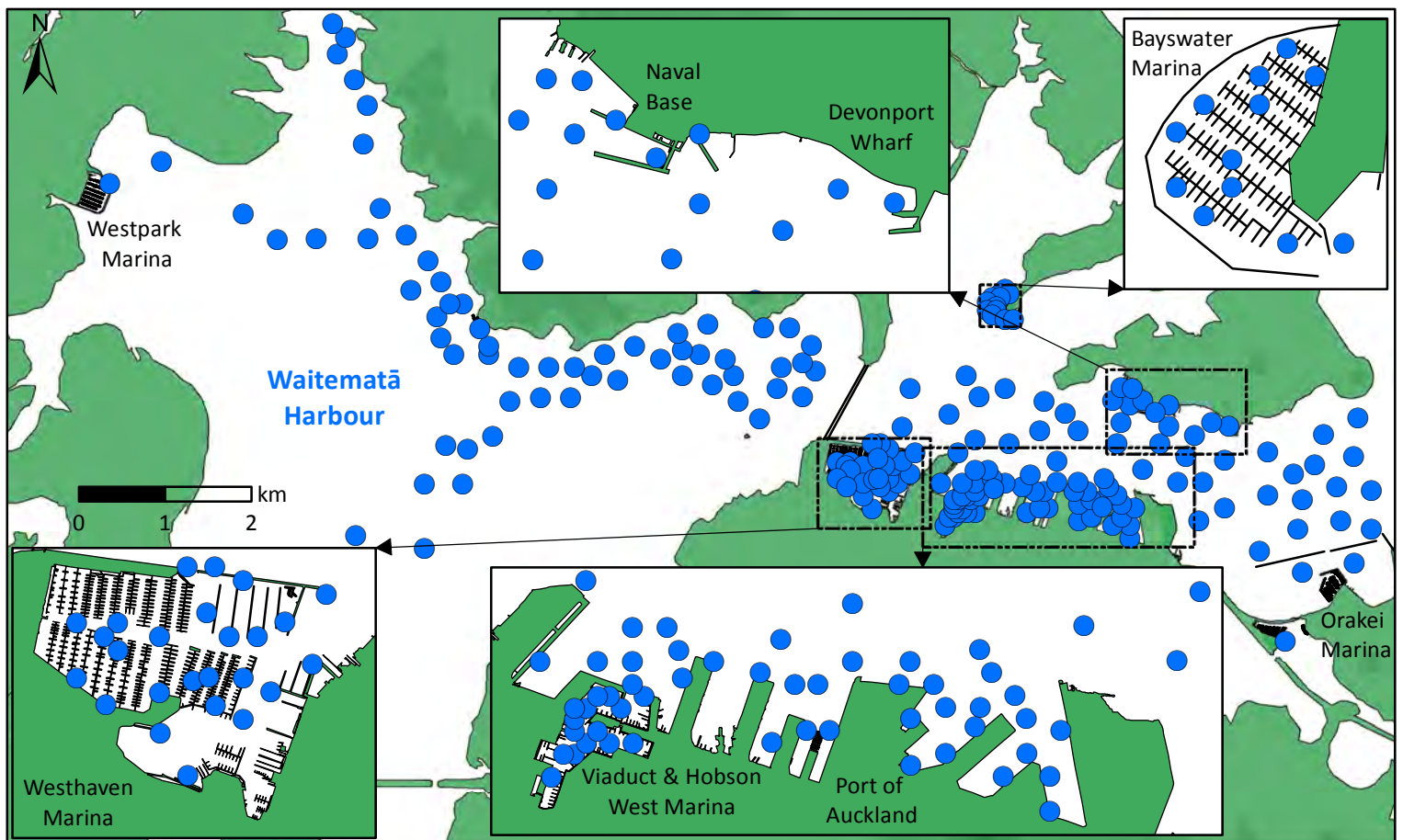
Benthic sled (BSLD) locations



Waitematā Harbour

Summer 2017-18

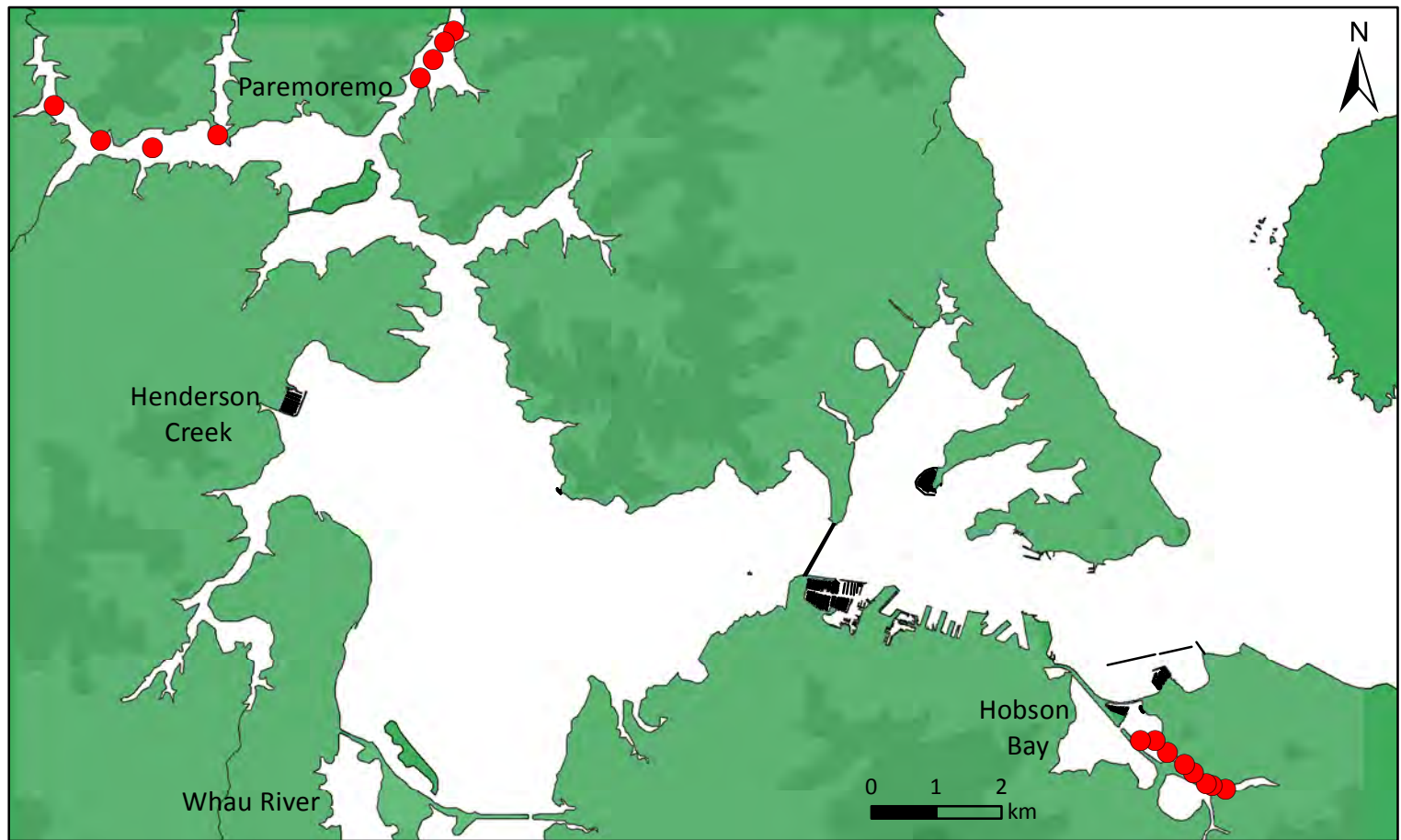
Benthic sled (BSLD) locations



Waitematā Harbour

Winter 2017

Crab condo (CONDO) locations



Waitematā Harbour

Summer 2017-18

Crab condo (CONDO) locations



Waitematā Harbour

Winter 2017

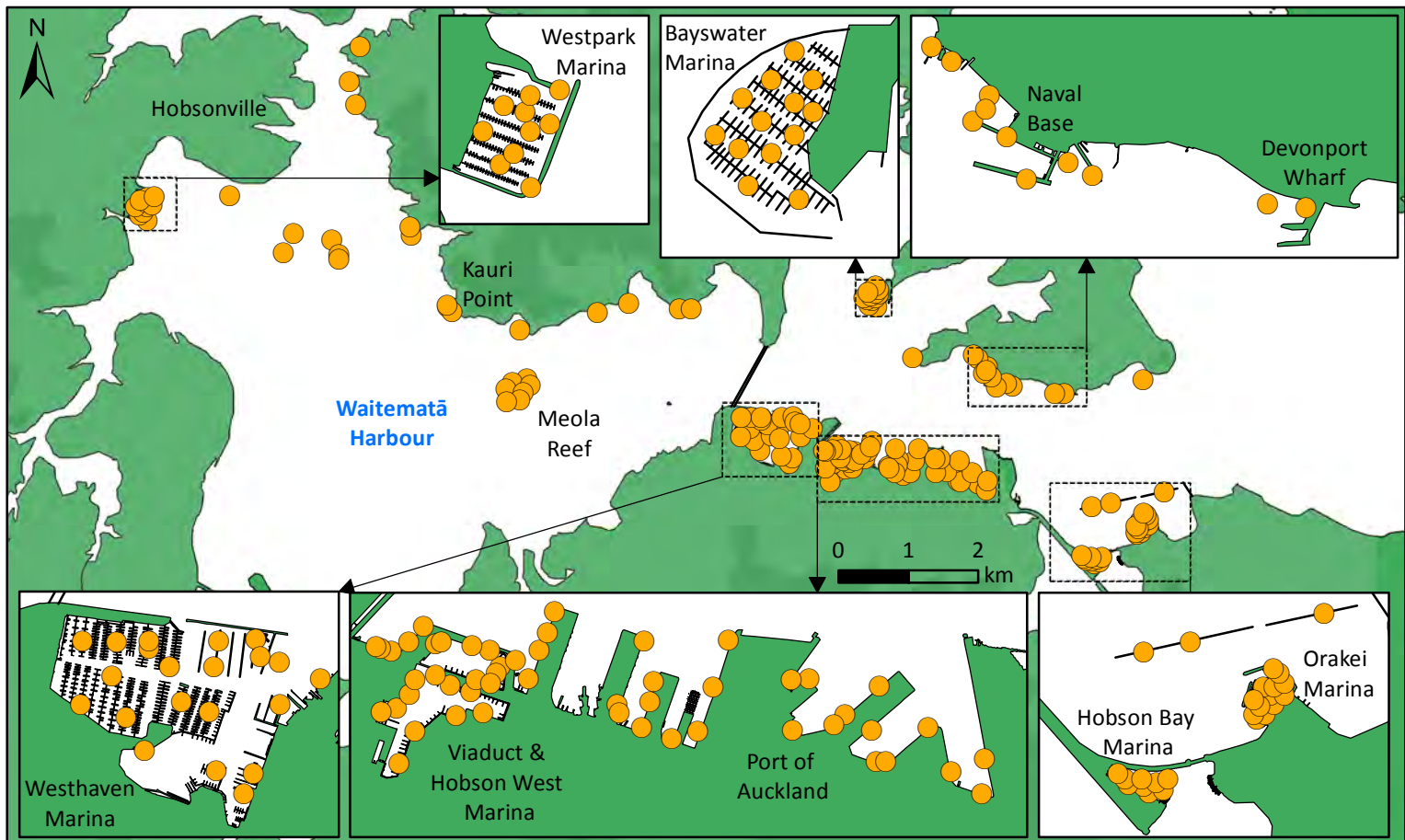
Crab (box) trap (CRBTP) locations



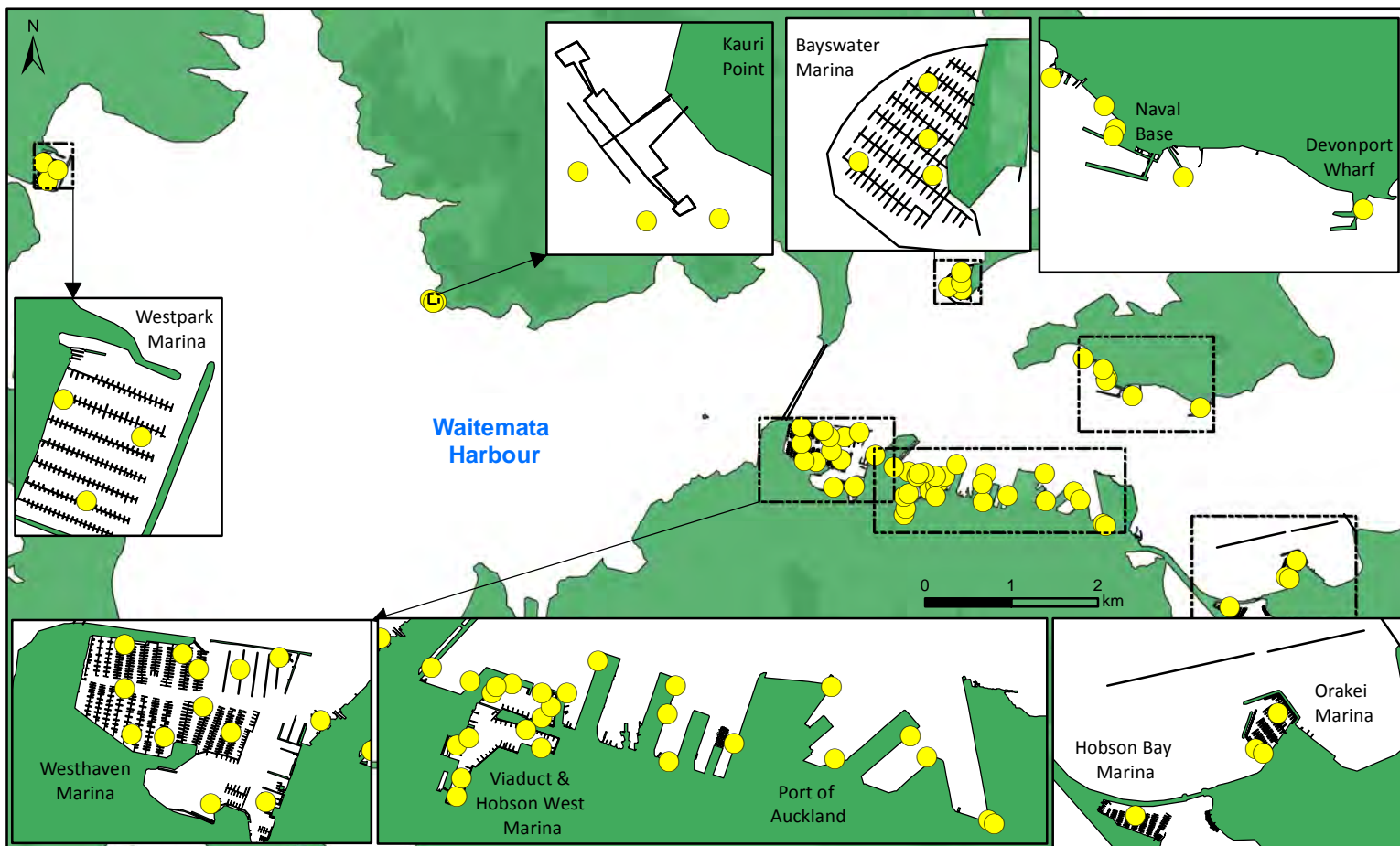
Waitematā Harbour

Summer 2017-18

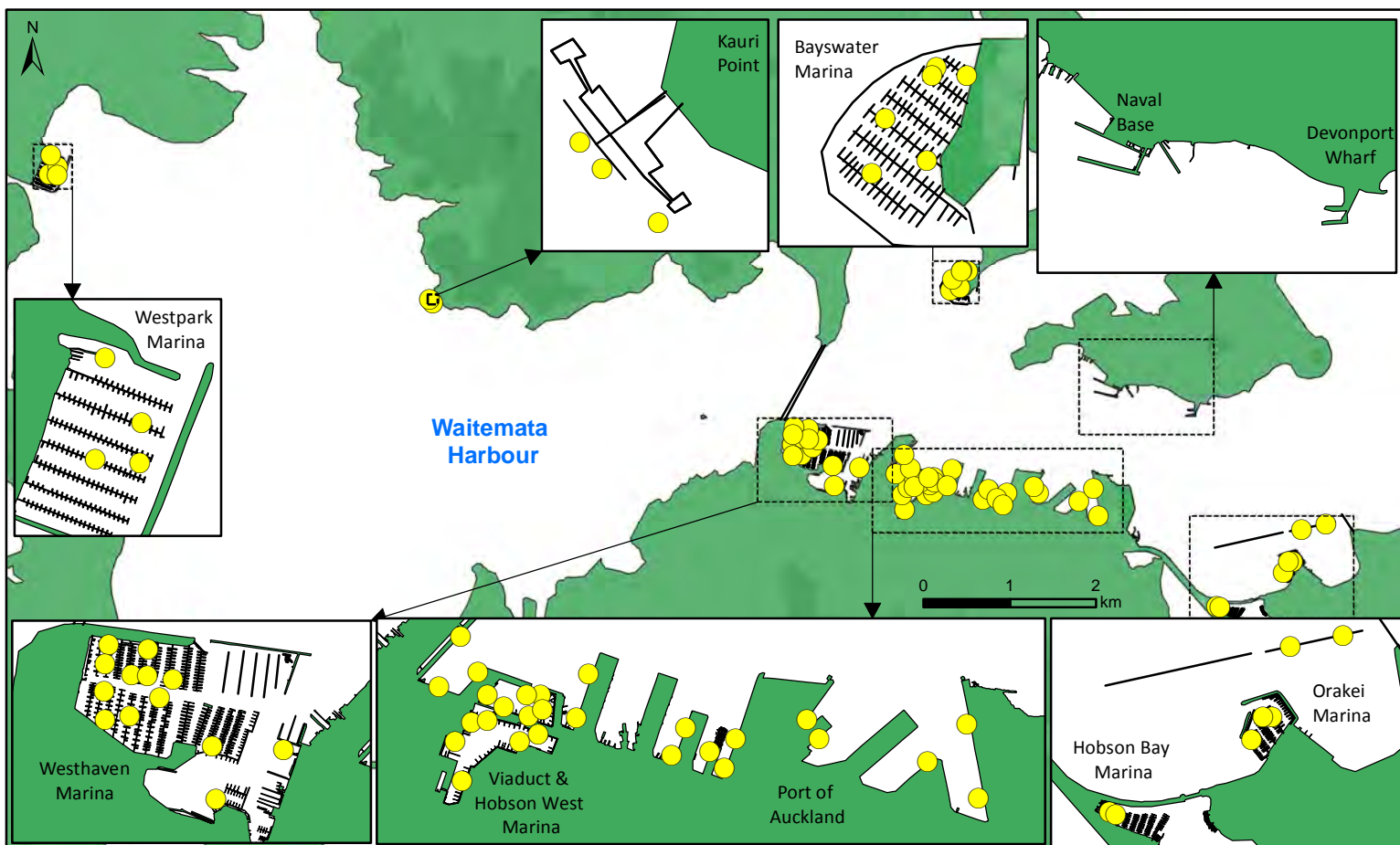
Crab (box) trap (CRBTP) locations



Waitemata Harbour
 Winter 2017
 Diver search (VISD) locations



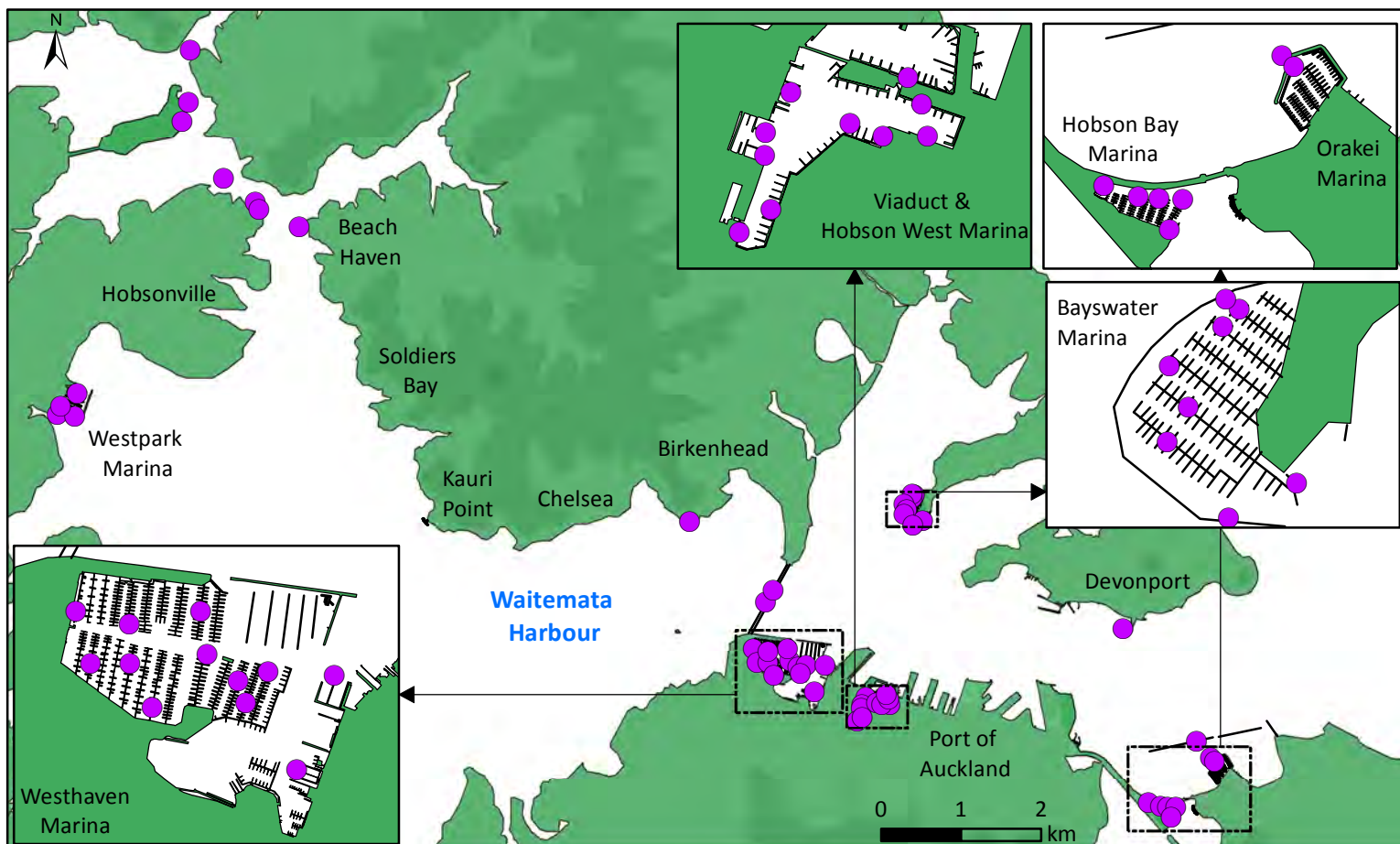
Waitemata Harbour
 Summer 2017-18
 Diver search (VISD) locations



Waitemata Harbour

Winter 2017

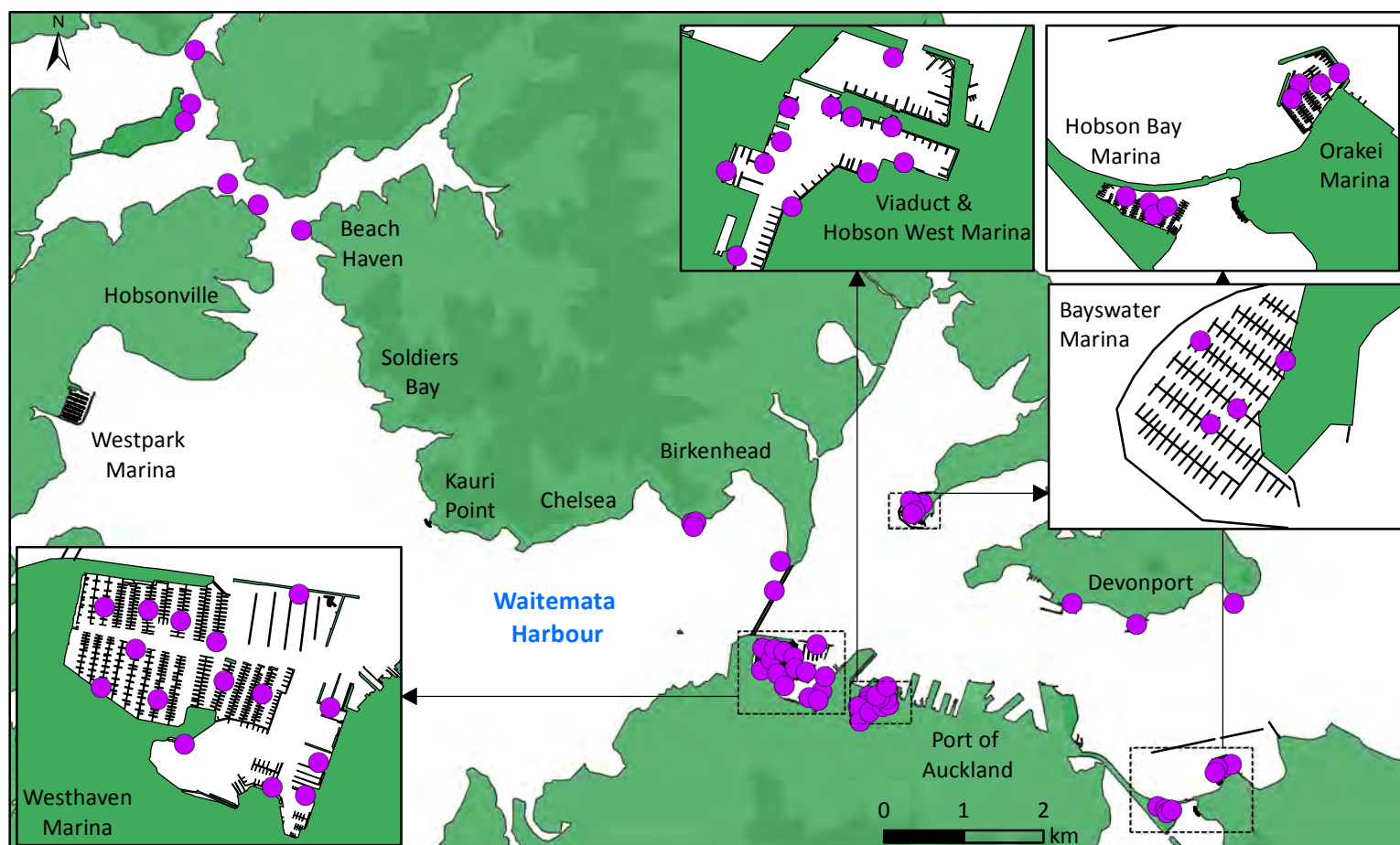
Shore search (WRACK) locations



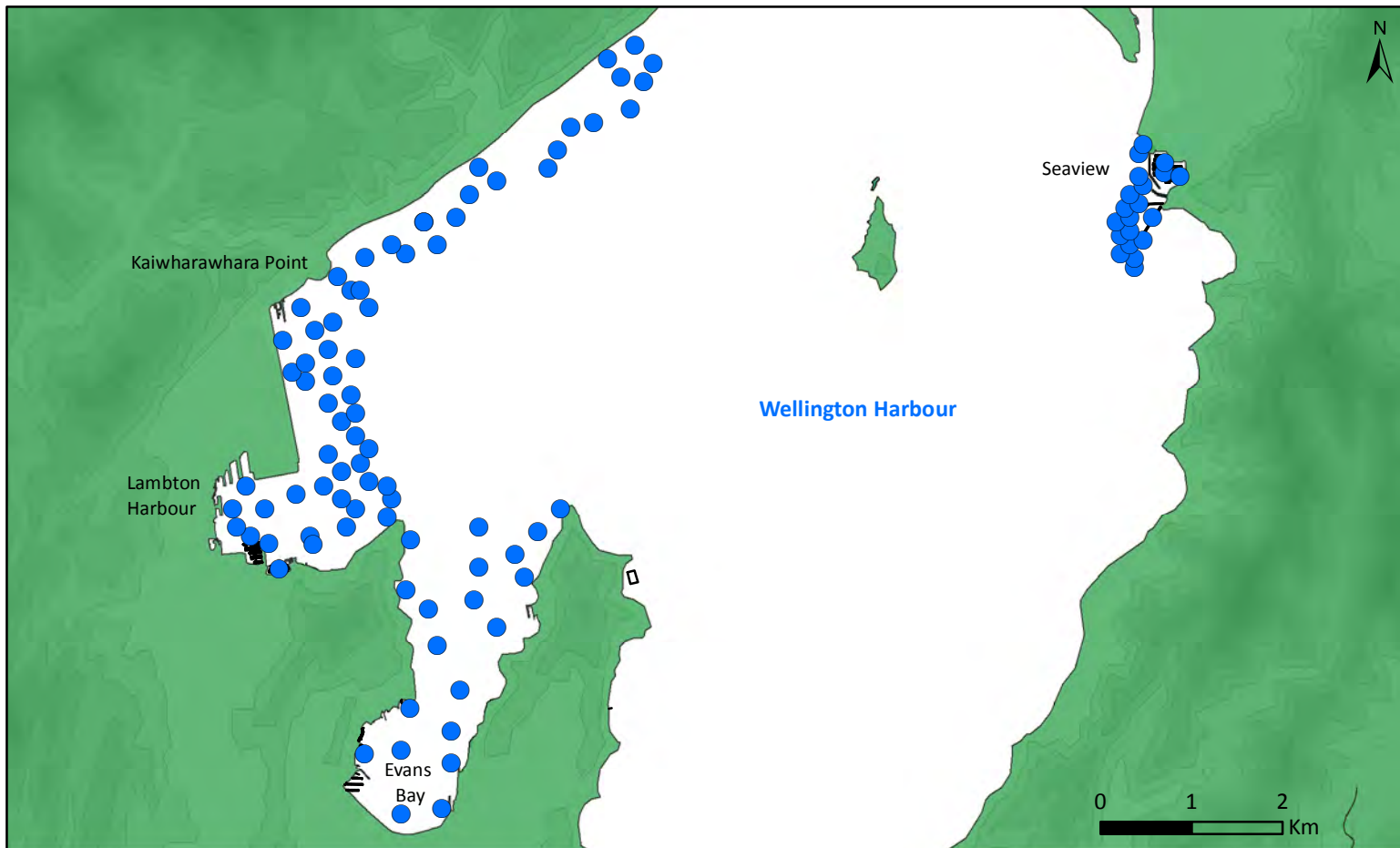
Waitemata Harbour

Summer 2017-18

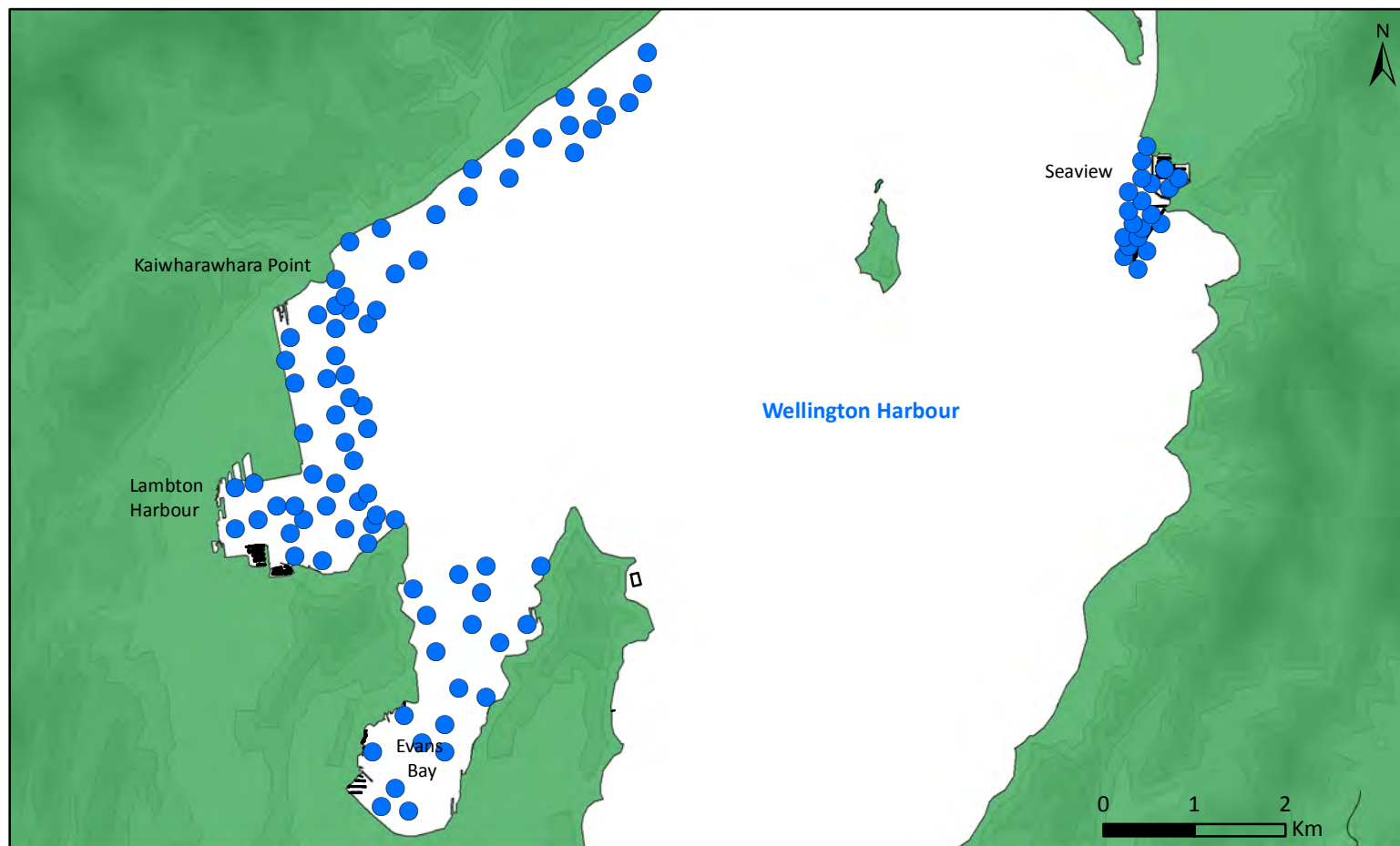
Shore search (WRACK) locations



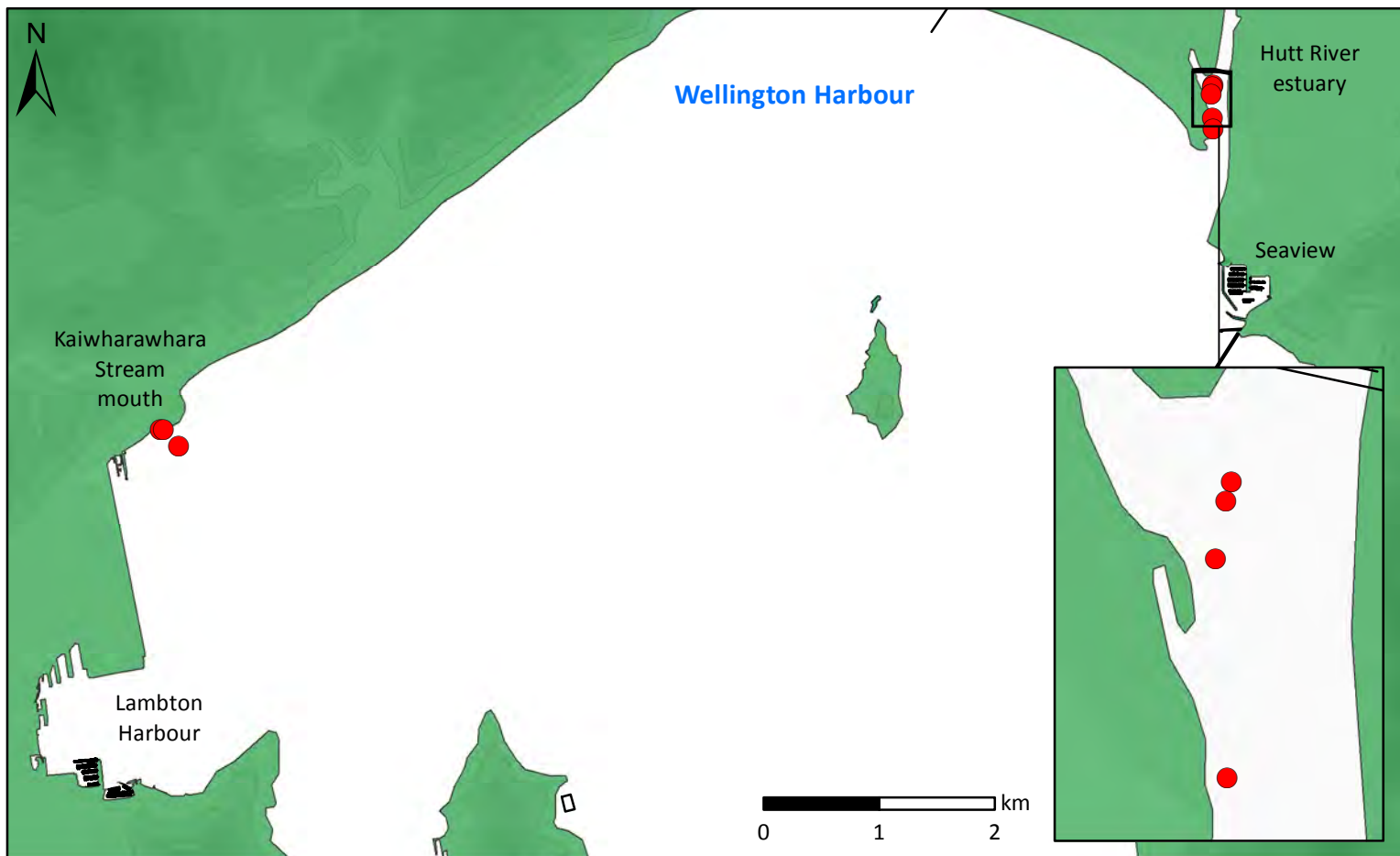
Wellington Harbour
Winter 2017
Benthic sled (BSLD) locations



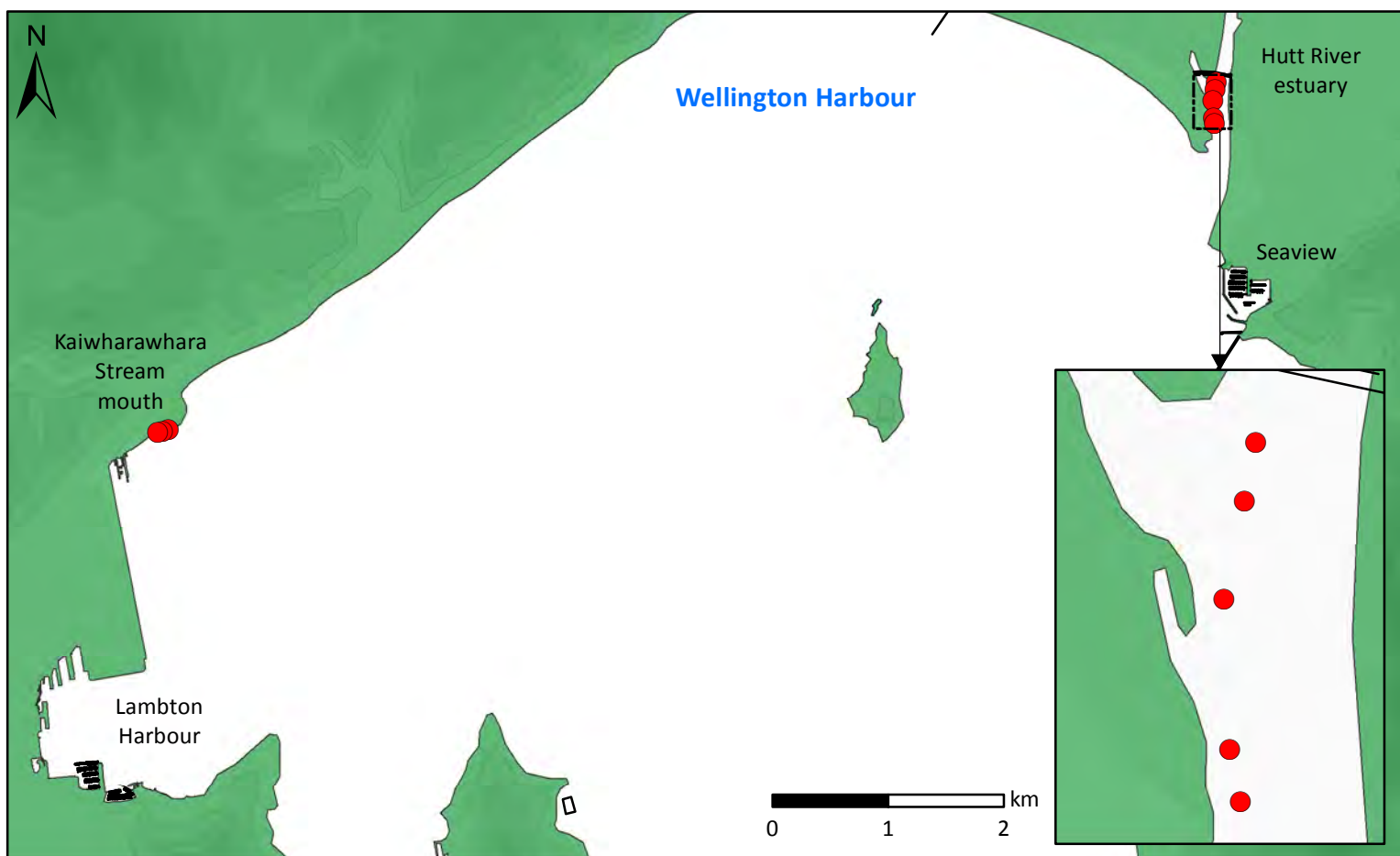
Wellington Harbour
Summer 2017-18
Benthic sled (BSLD) locations



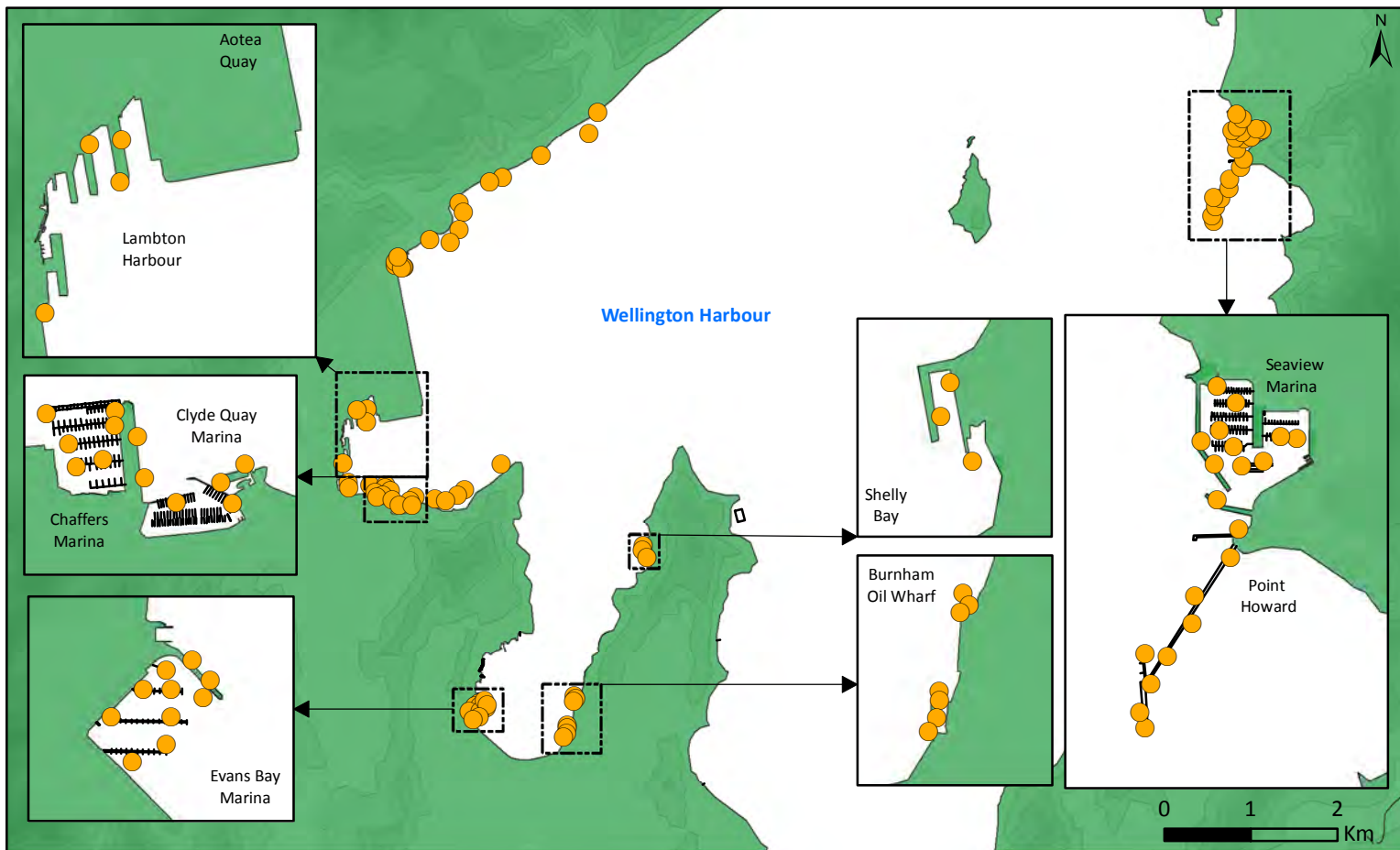
Wellington Harbour
Winter 2017
Crab condo (CONDO) locations



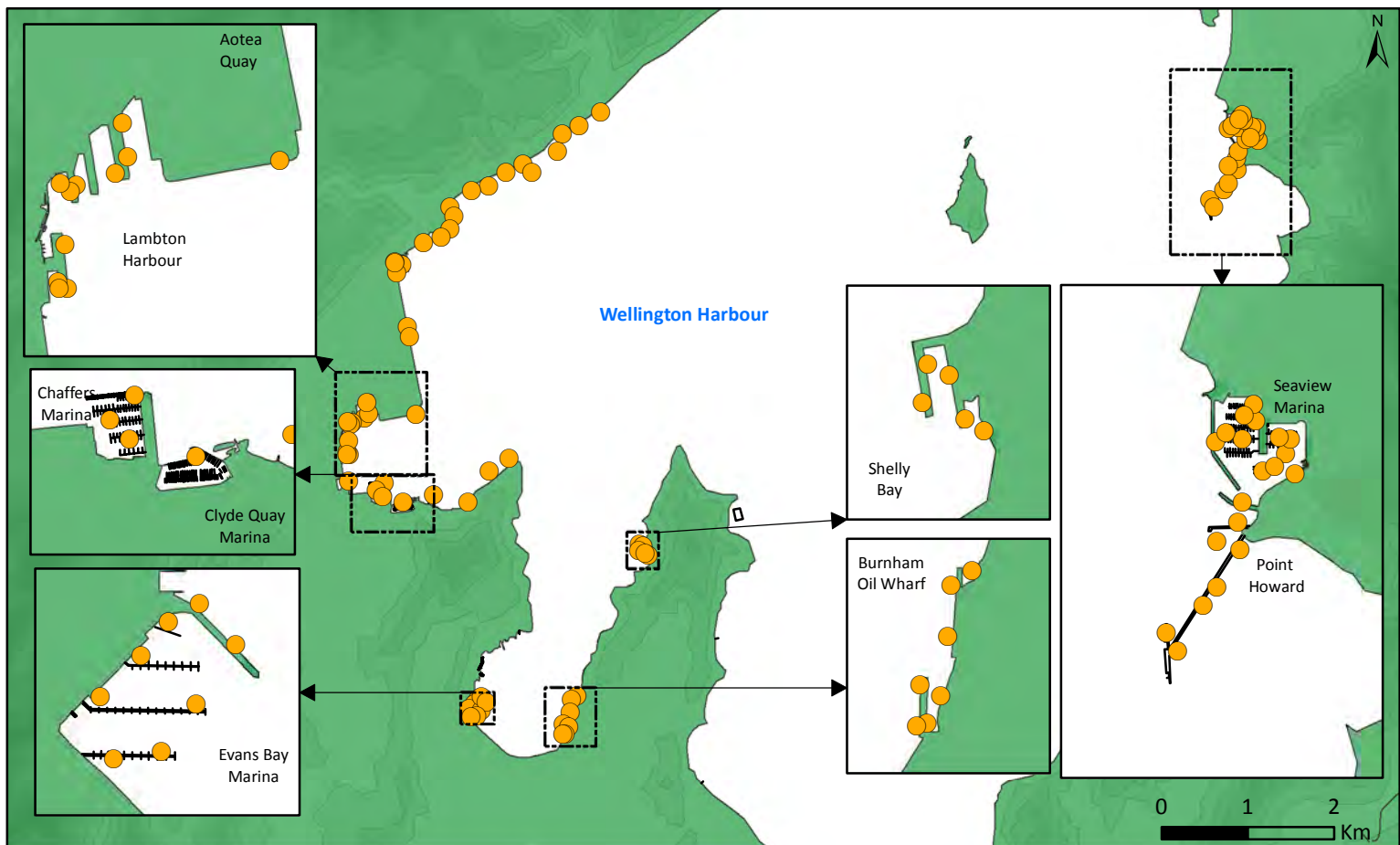
Wellington Harbour
Summer 2017-18
Crab condo (CONDO) locations



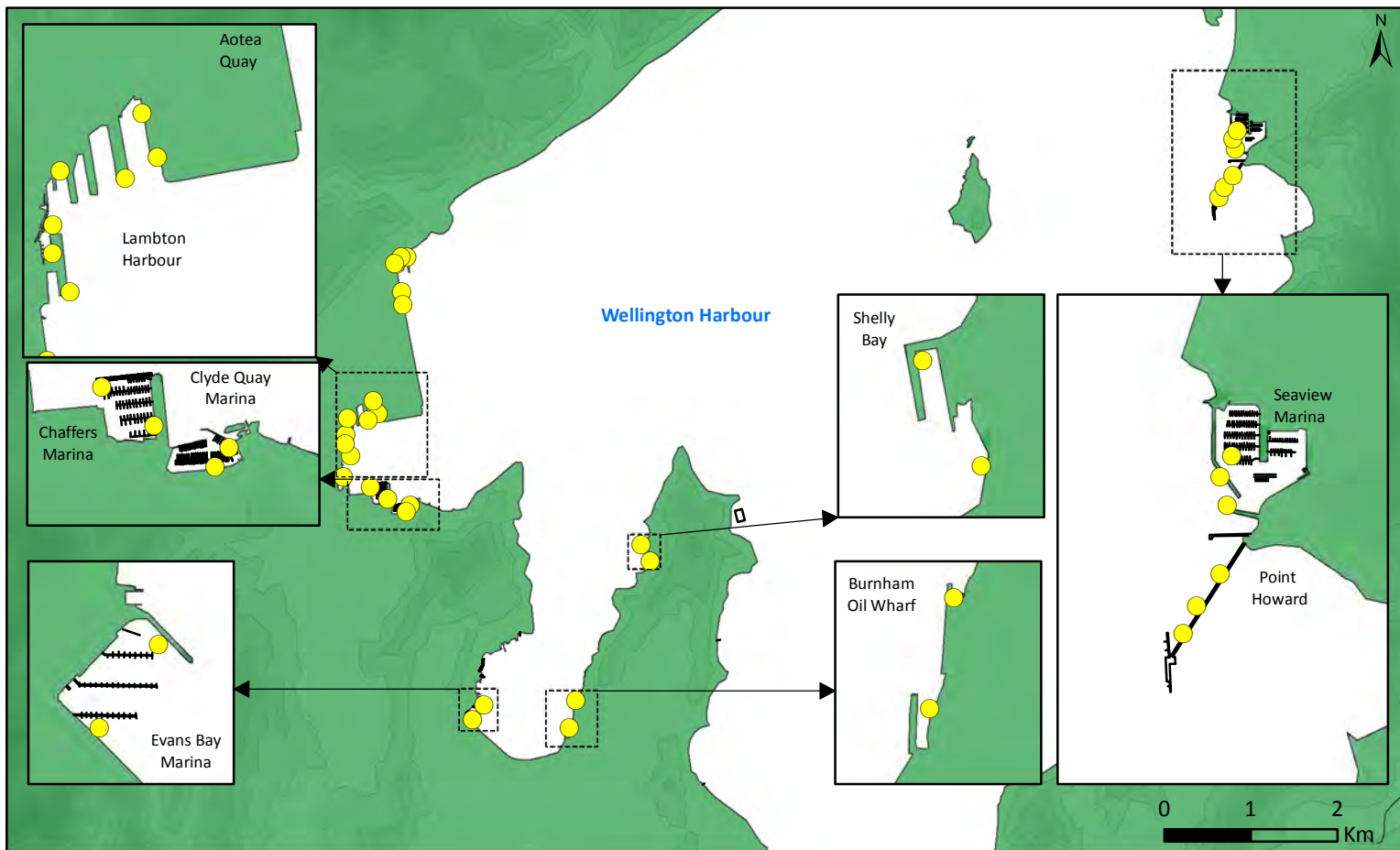
Wellington Harbour
Winter 2017
Crab traps (CRBTP) locations



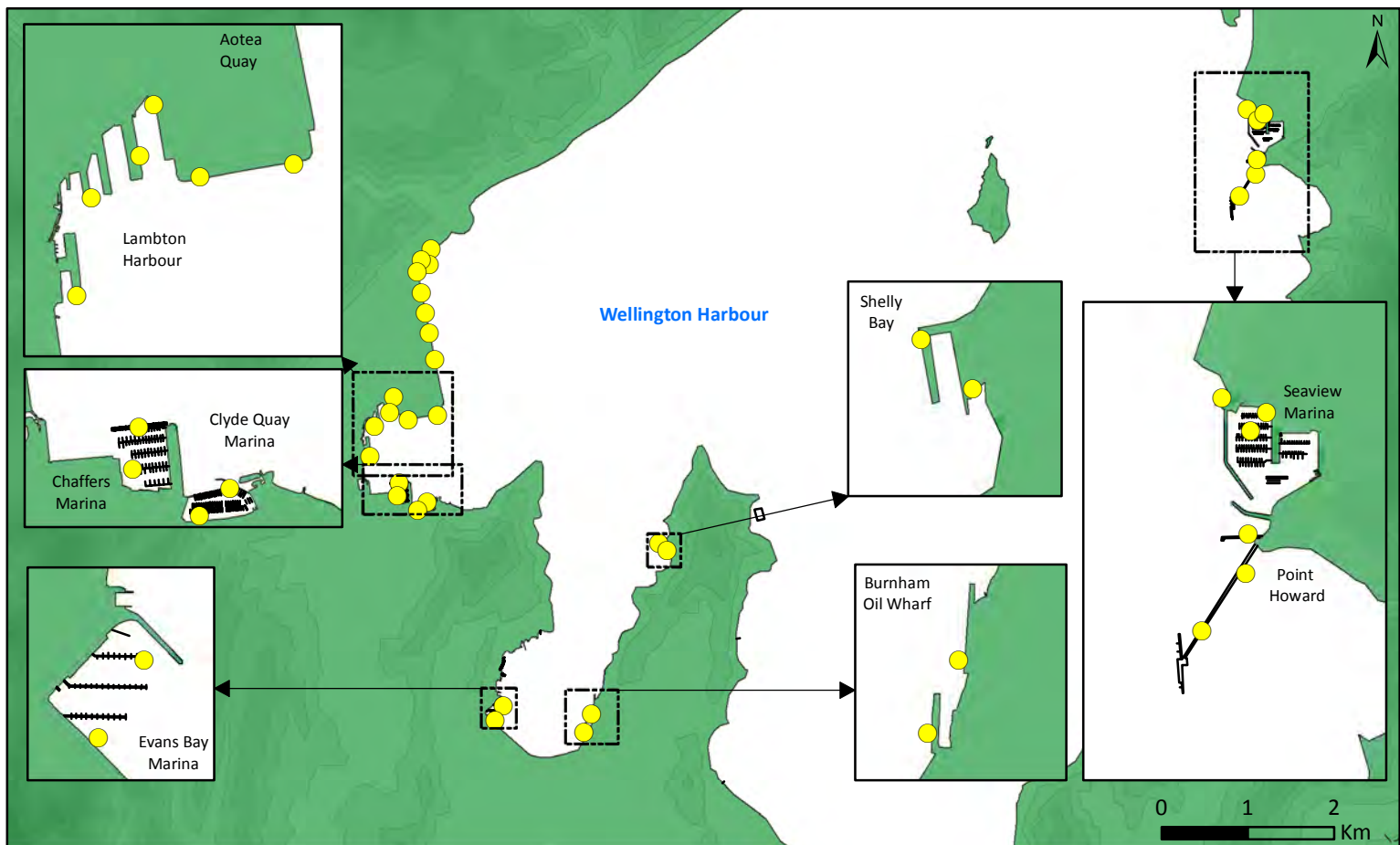
Wellington Harbour
Summer 2017-18
Crab traps (CRBTP) locations



Wellington Harbour
Winter 2017
Diver searches (VISD) locations



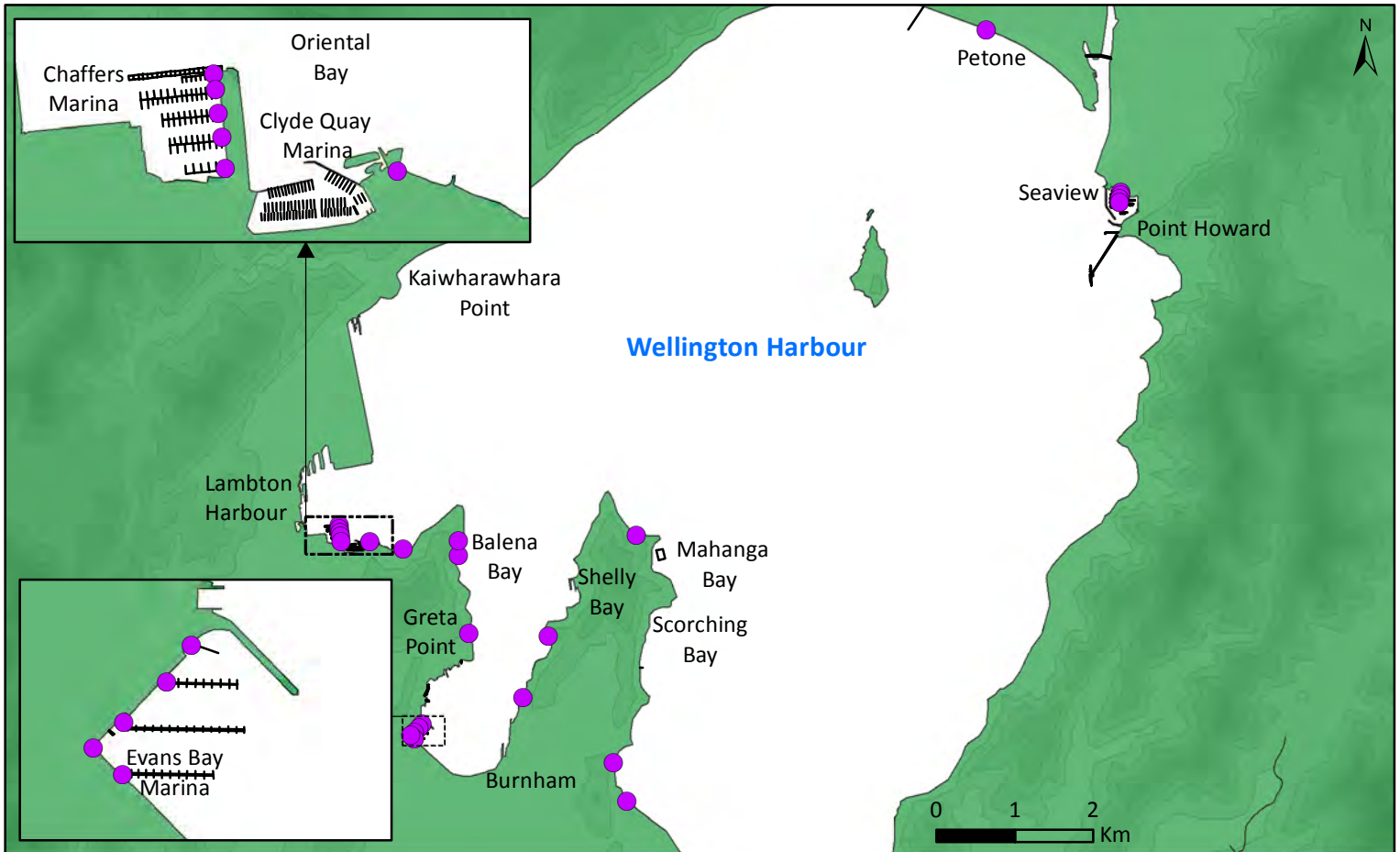
Wellington Harbour
Summer 2017-18
Diver searches (VISD) locations



Wellington Harbour

Winter 2017

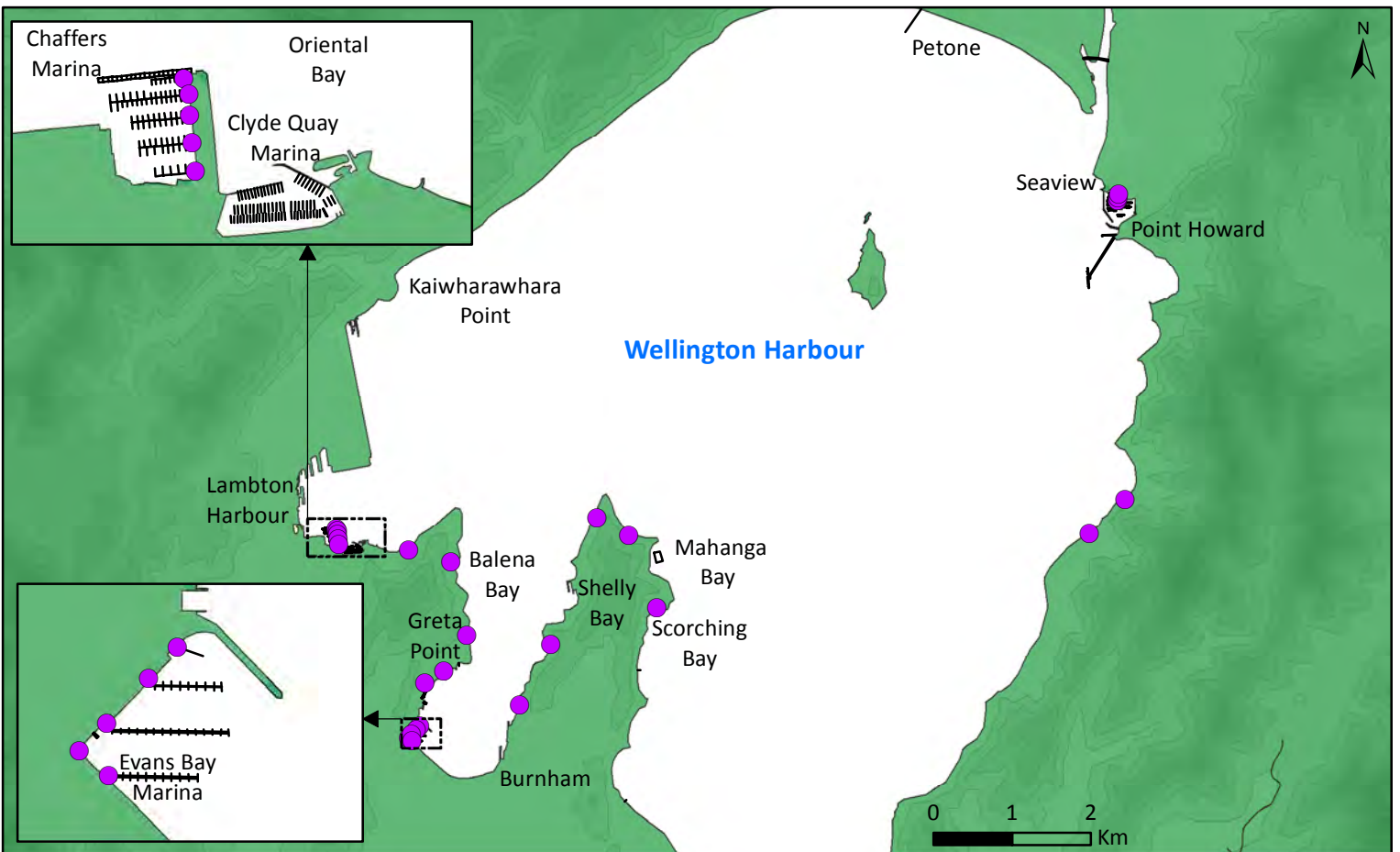
Shore search (WRACK) locations



Wellington Harbour

Summer 2017-18

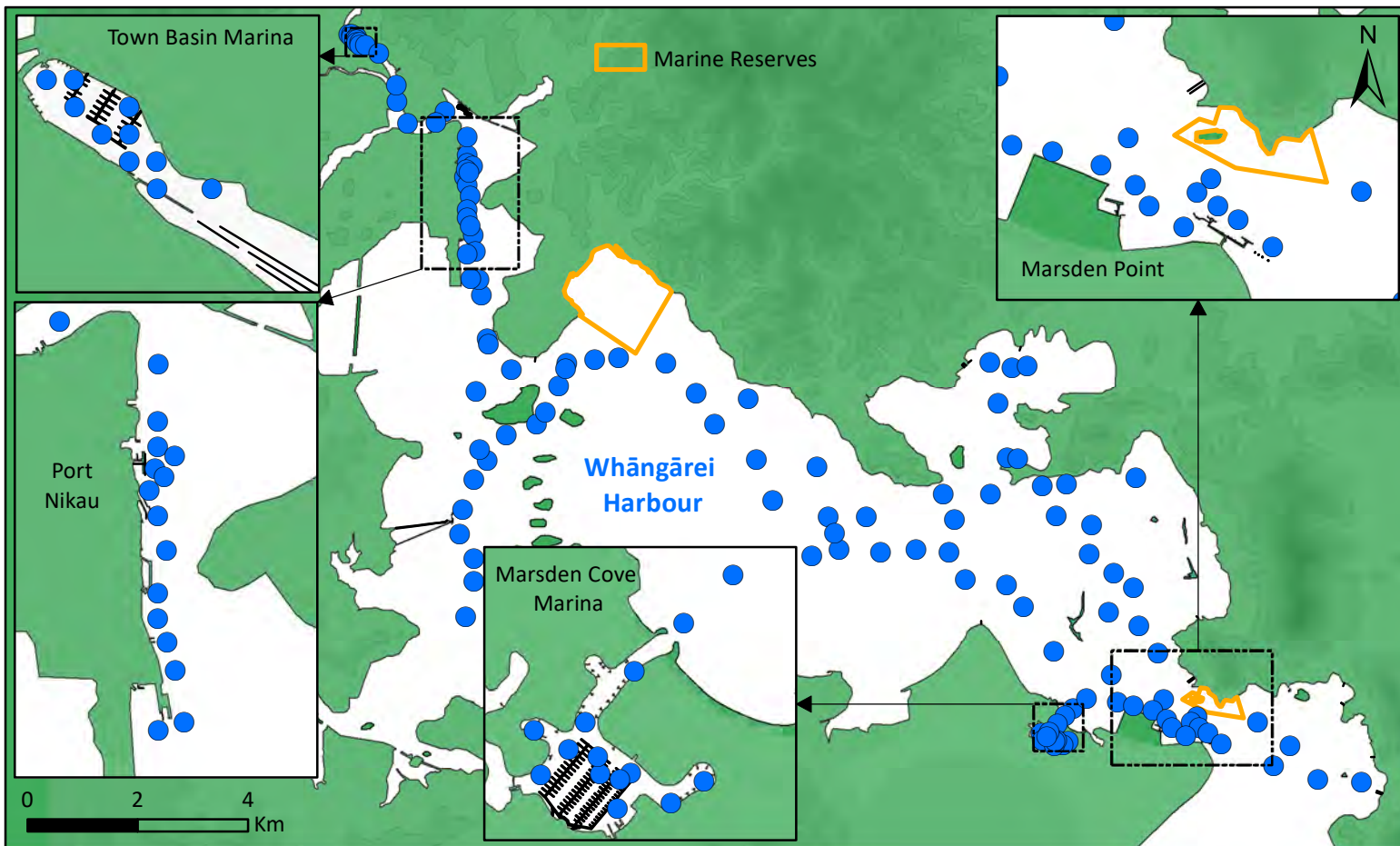
Shore search (WRACK) locations



Whāngārei Harbour

Winter 2017

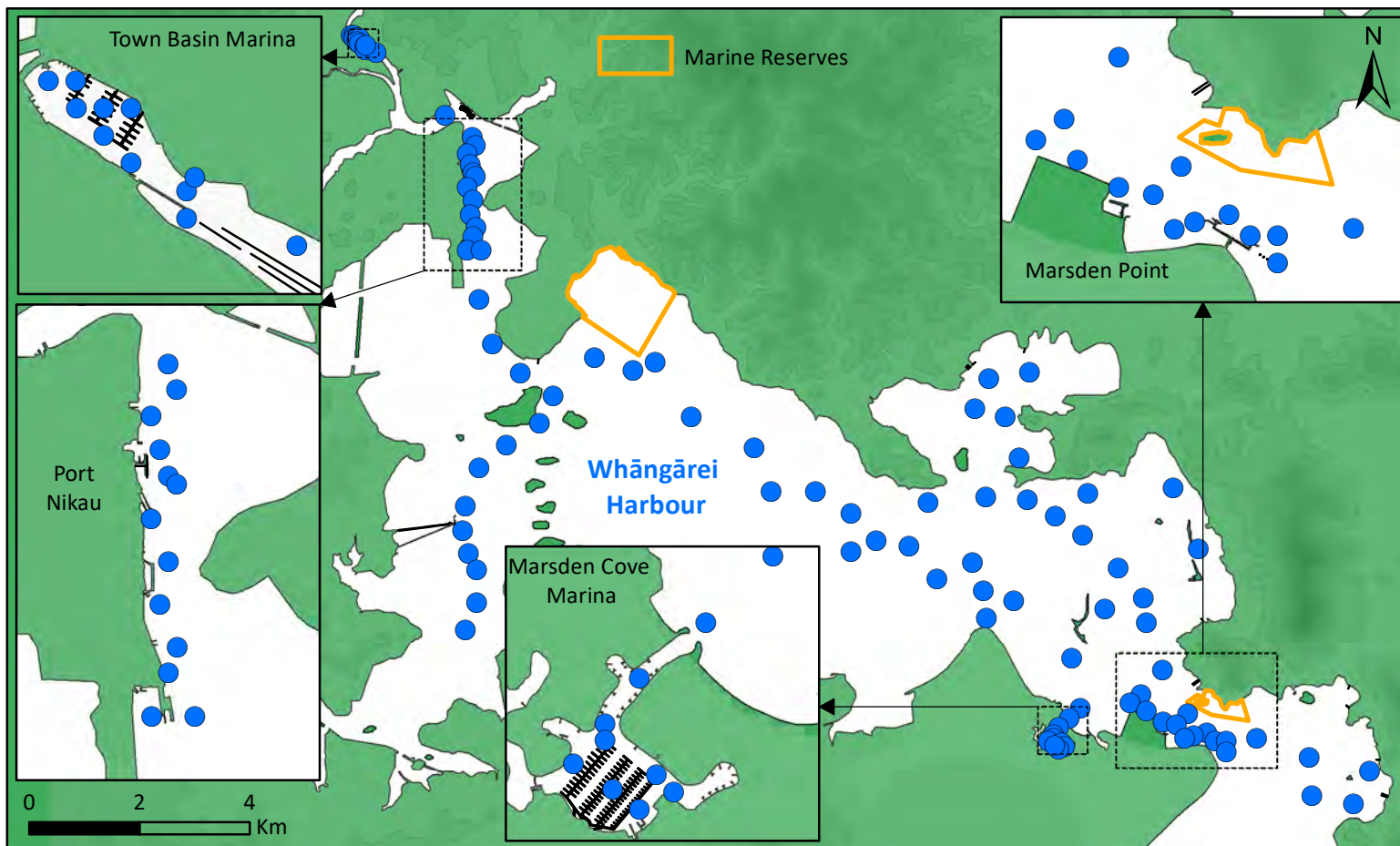
Benthic sled (BSLD) locations



Whāngārei Harbour

Summer 2017-18

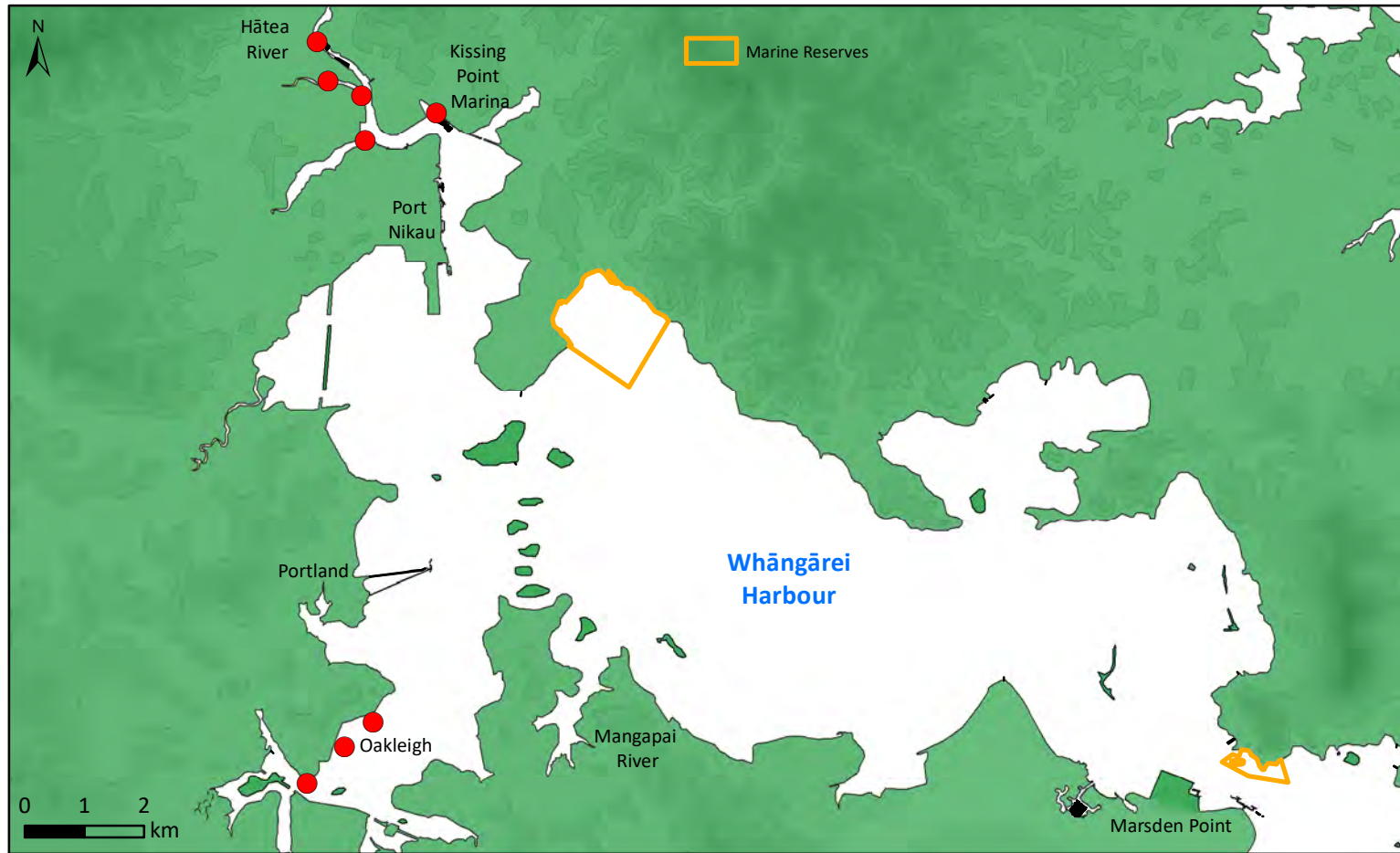
Benthic sled (BSLD) locations



Whāngārei Harbour

Winter 2017

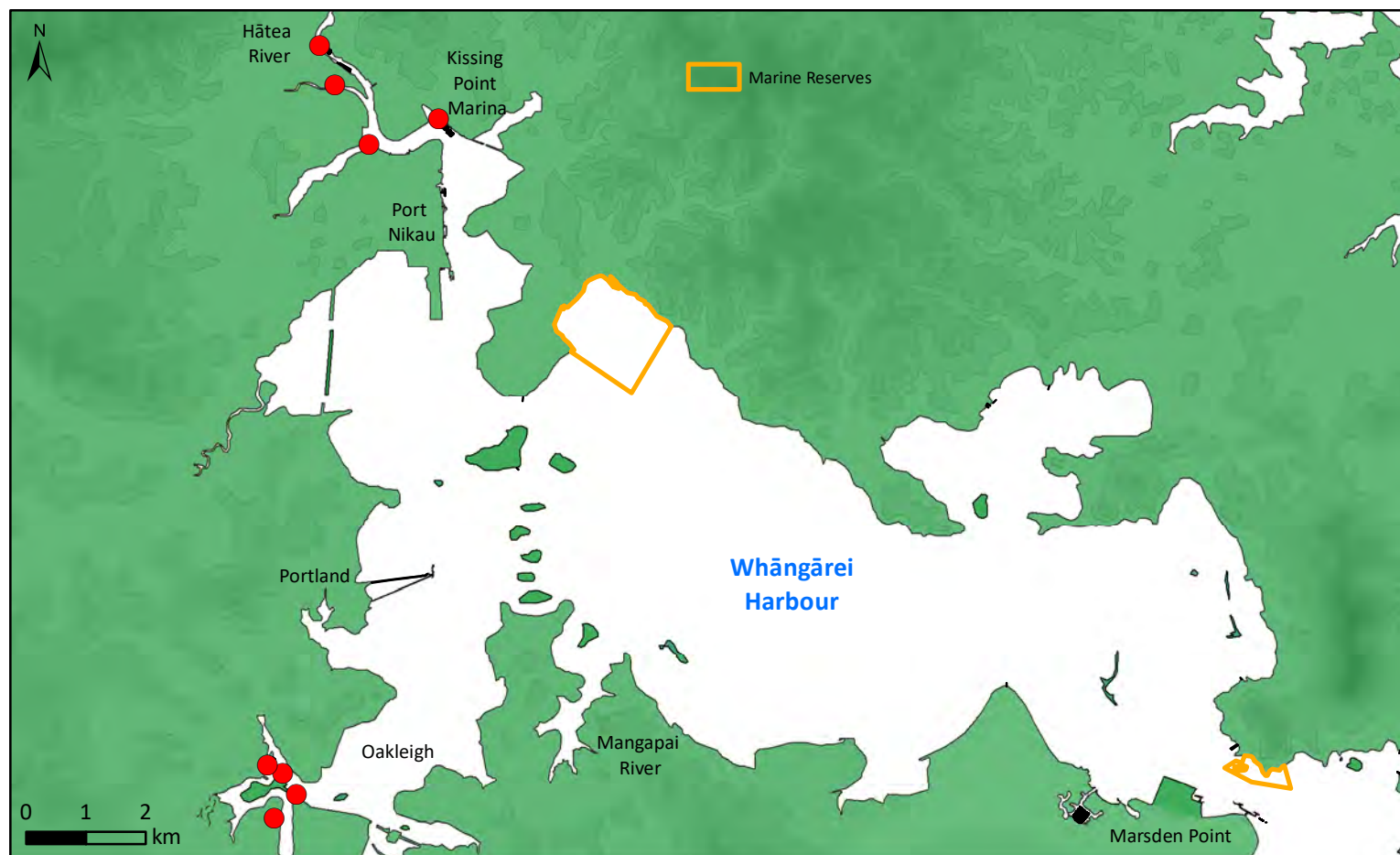
Crab condo (CONDO) locations



Whāngārei Harbour

Summer 2017-18

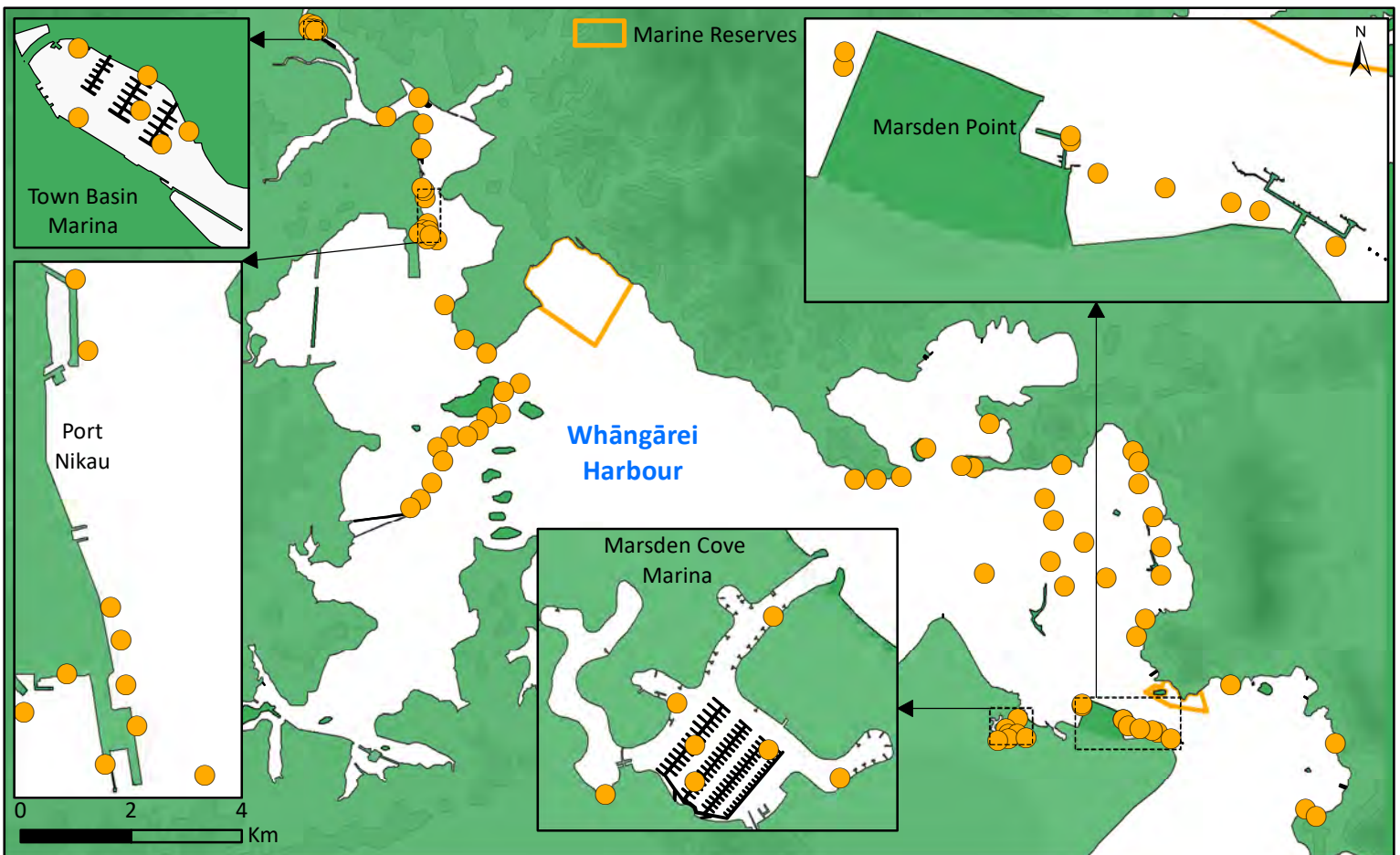
Crab condo (CONDO) locations



Whāngārei Harbour

Winter 2017

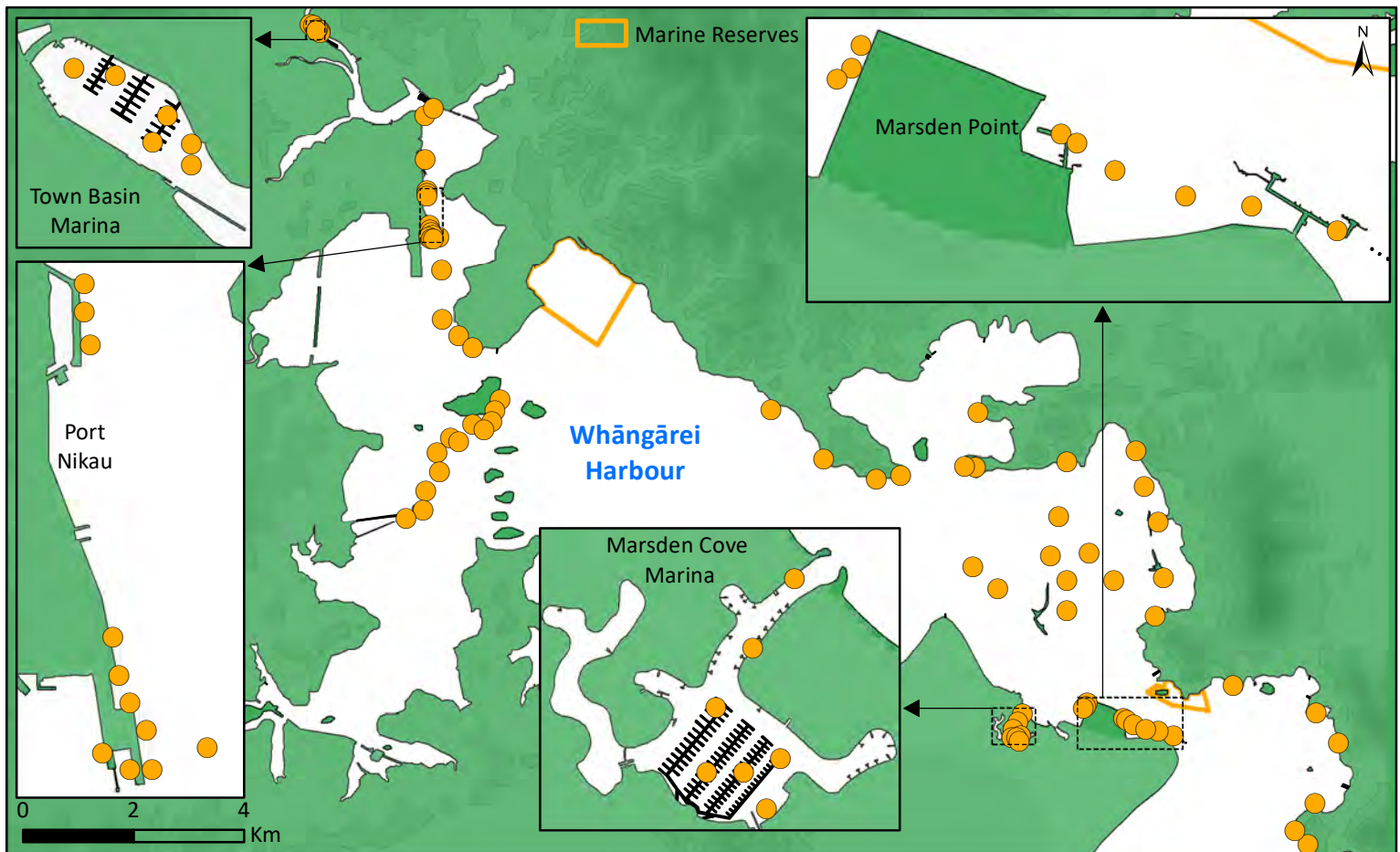
Crab trap (CRBTP) locations



Whāngārei Harbour

Summer 2017-18

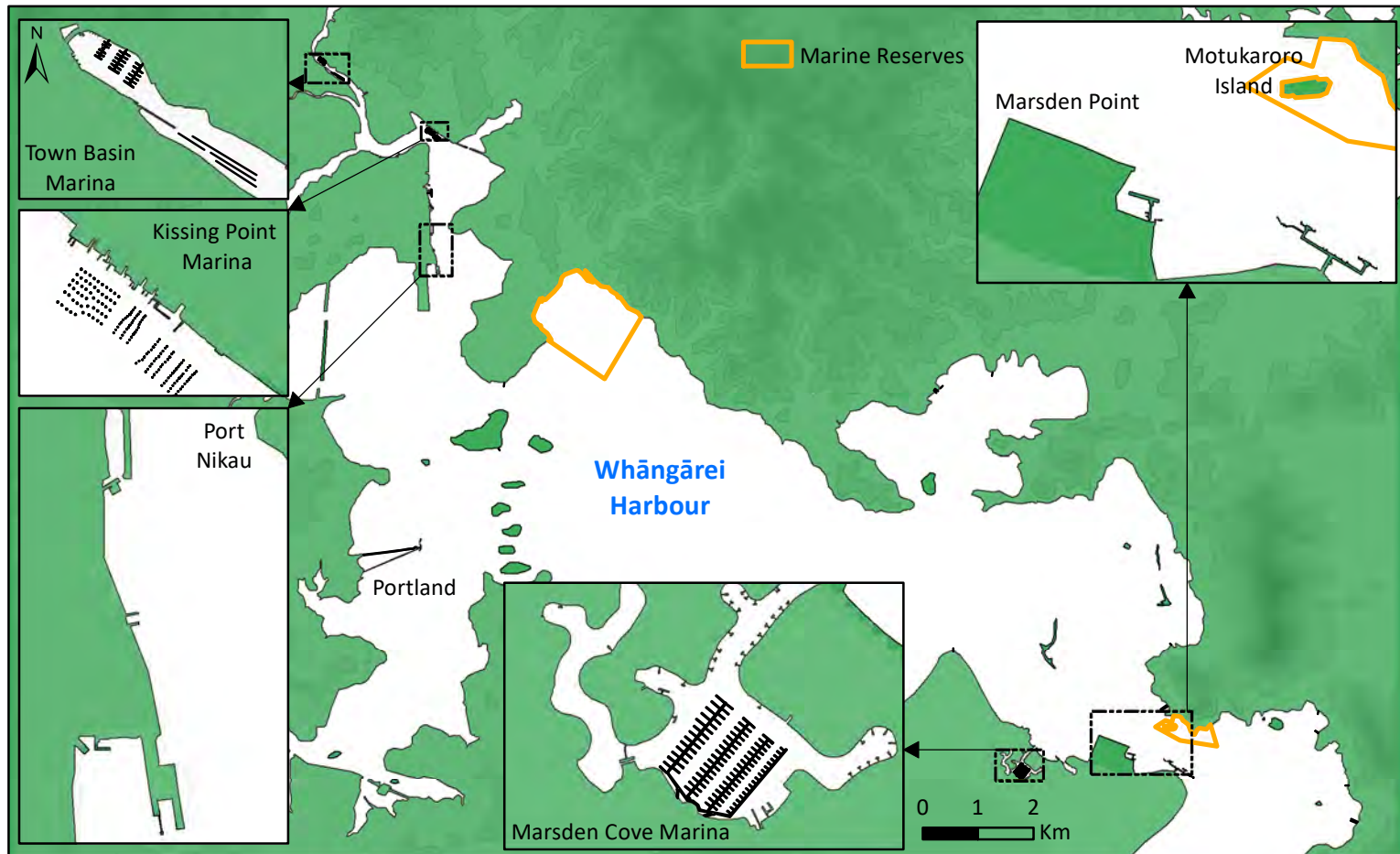
Crab trap (CRBTP) locations



Whāngārei Harbour

Winter 2017

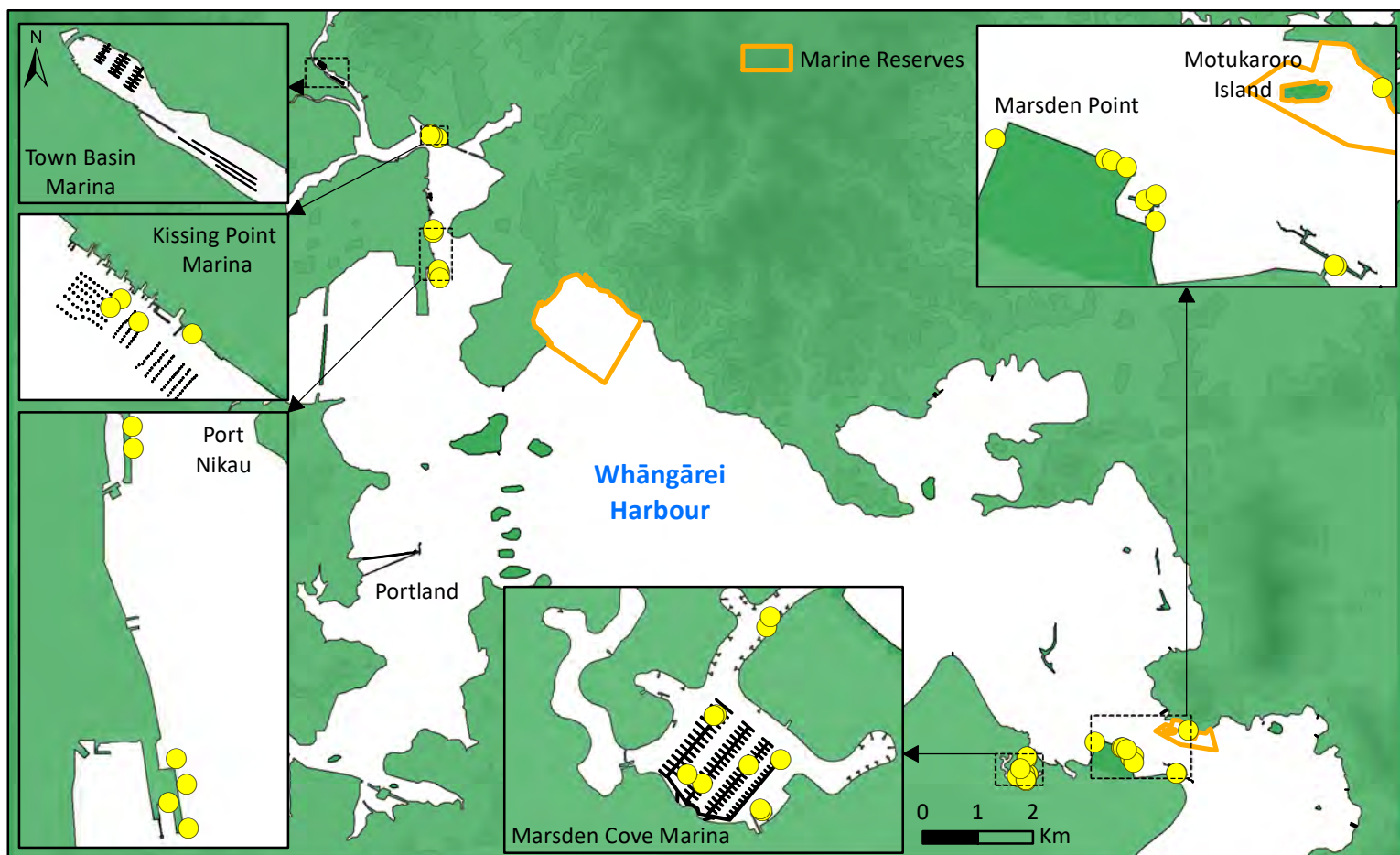
Diver search (VISD) locations



Whāngārei Harbour

Summer 2017-18

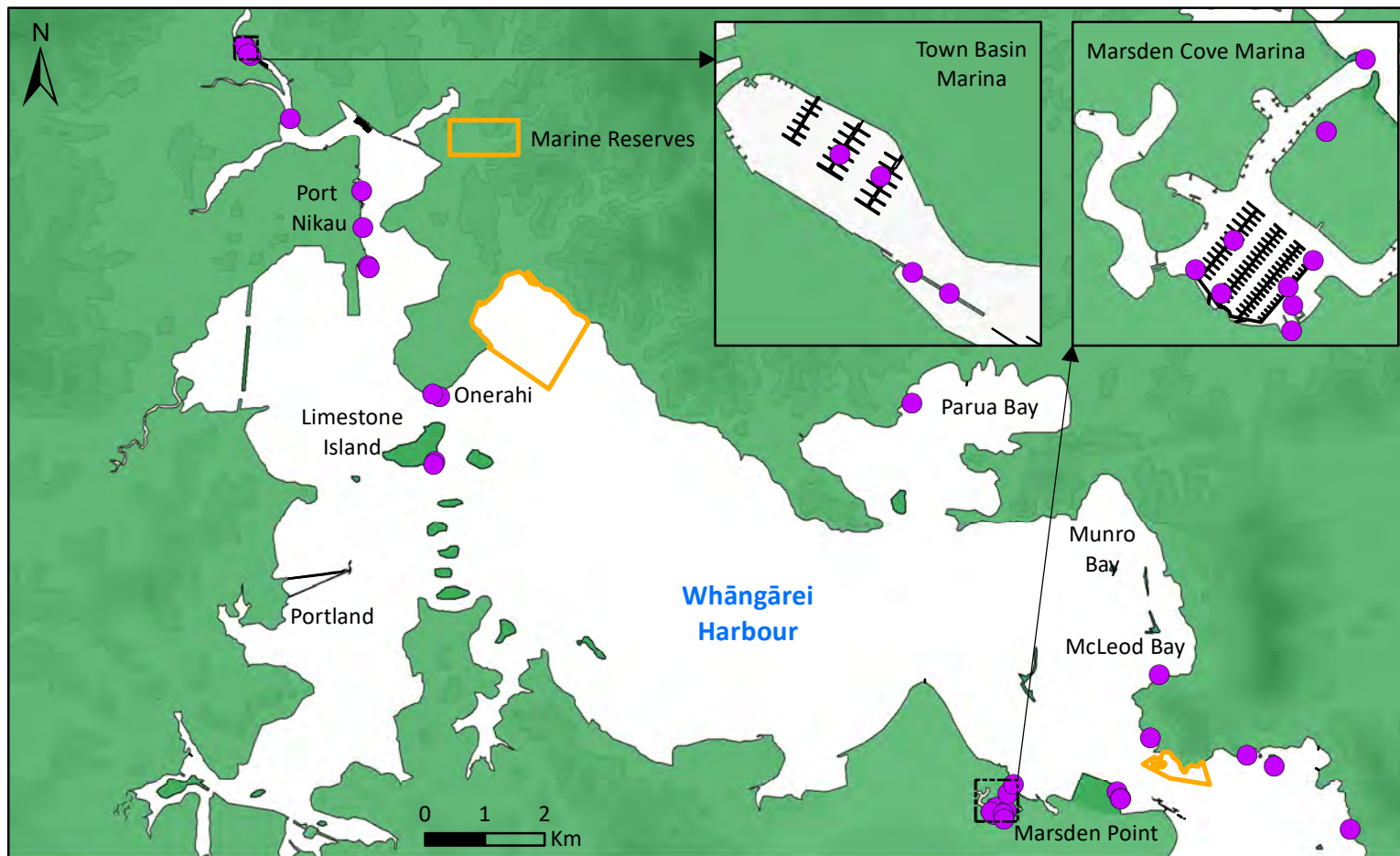
Diver search (VISD) locations



Whāngārei Harbour

Winter 2017

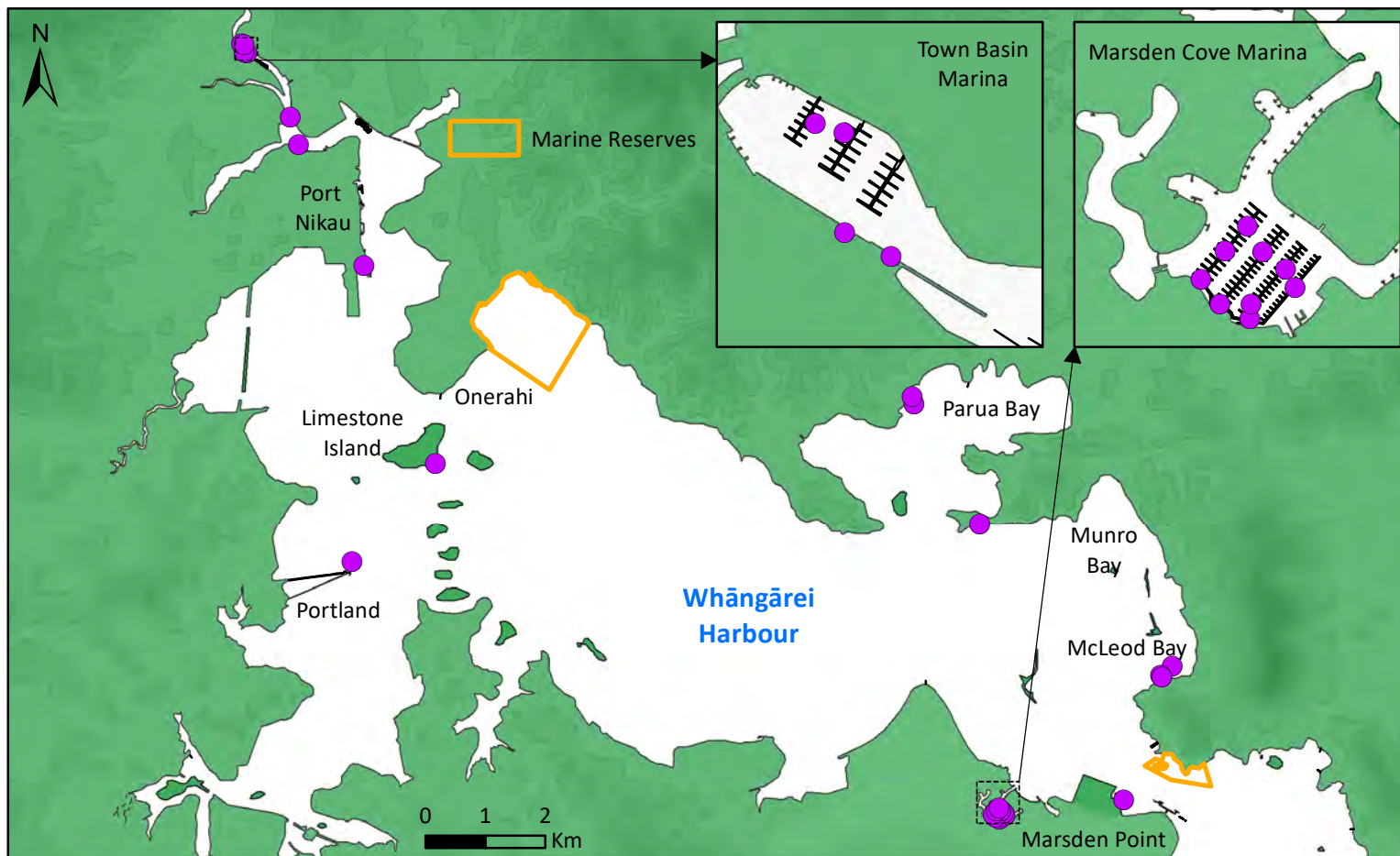
Shore search (WRACK) locations



Whāngārei Harbour

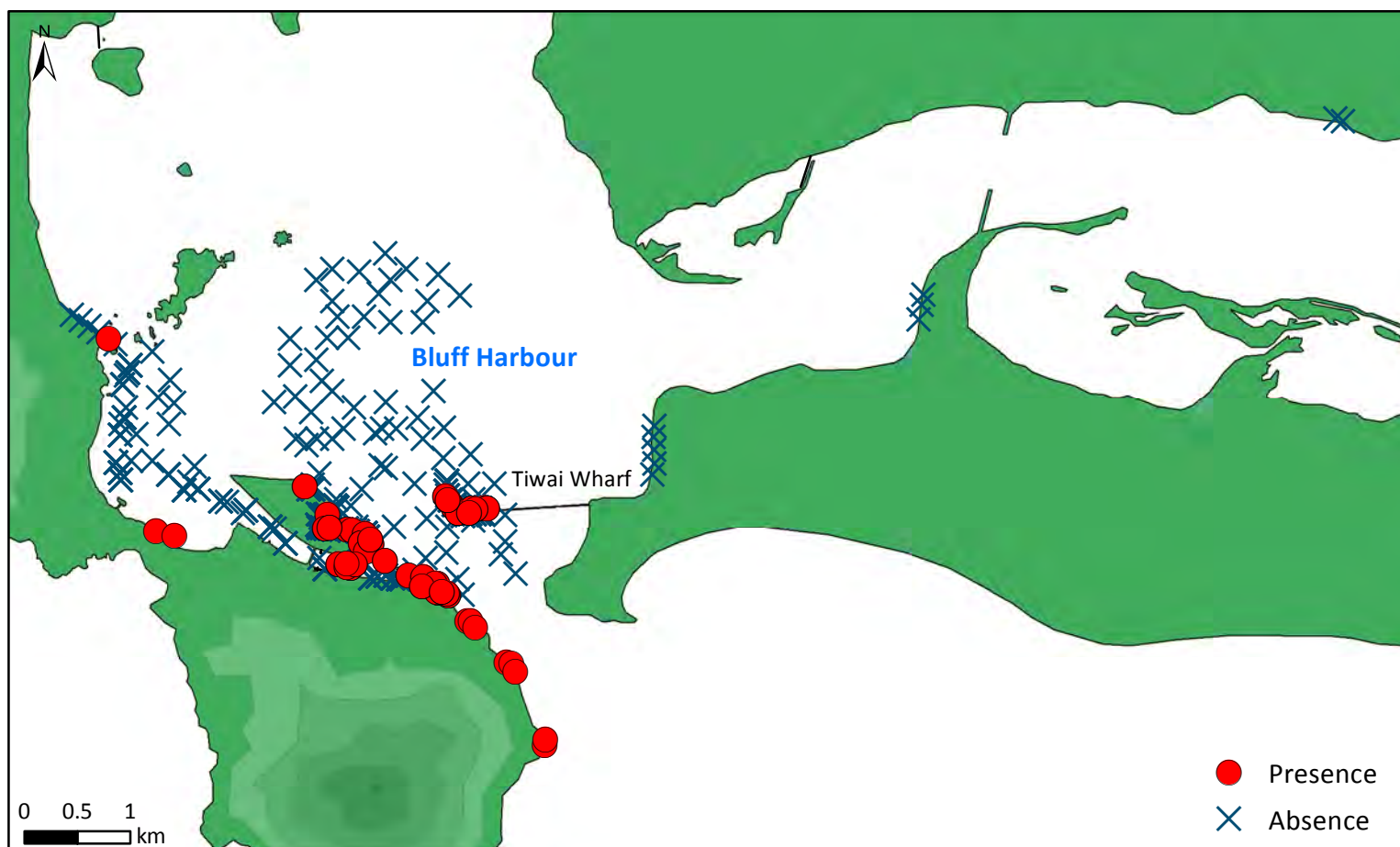
Summer 2017-18

Shore search (WRACK) locations

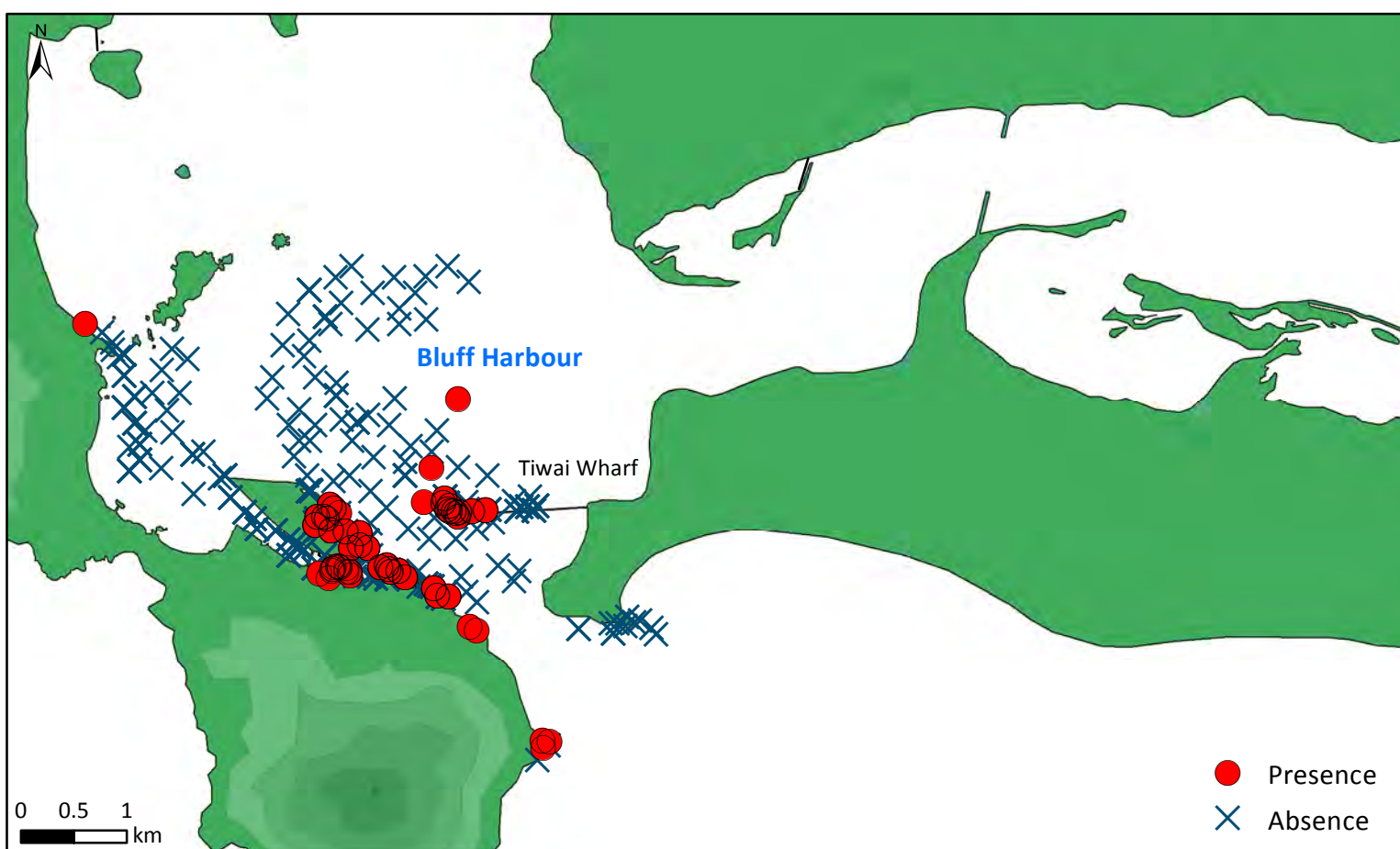


Appendix 4. Distribution maps for target and selected non-target non-indigenous species detected during Winter 2017 and Summer 2017–18 Marine High Risk Site Surveillance (MHRSS) programme surveys

Bluff Harbour
Winter 2017
Undaria pinnatifida



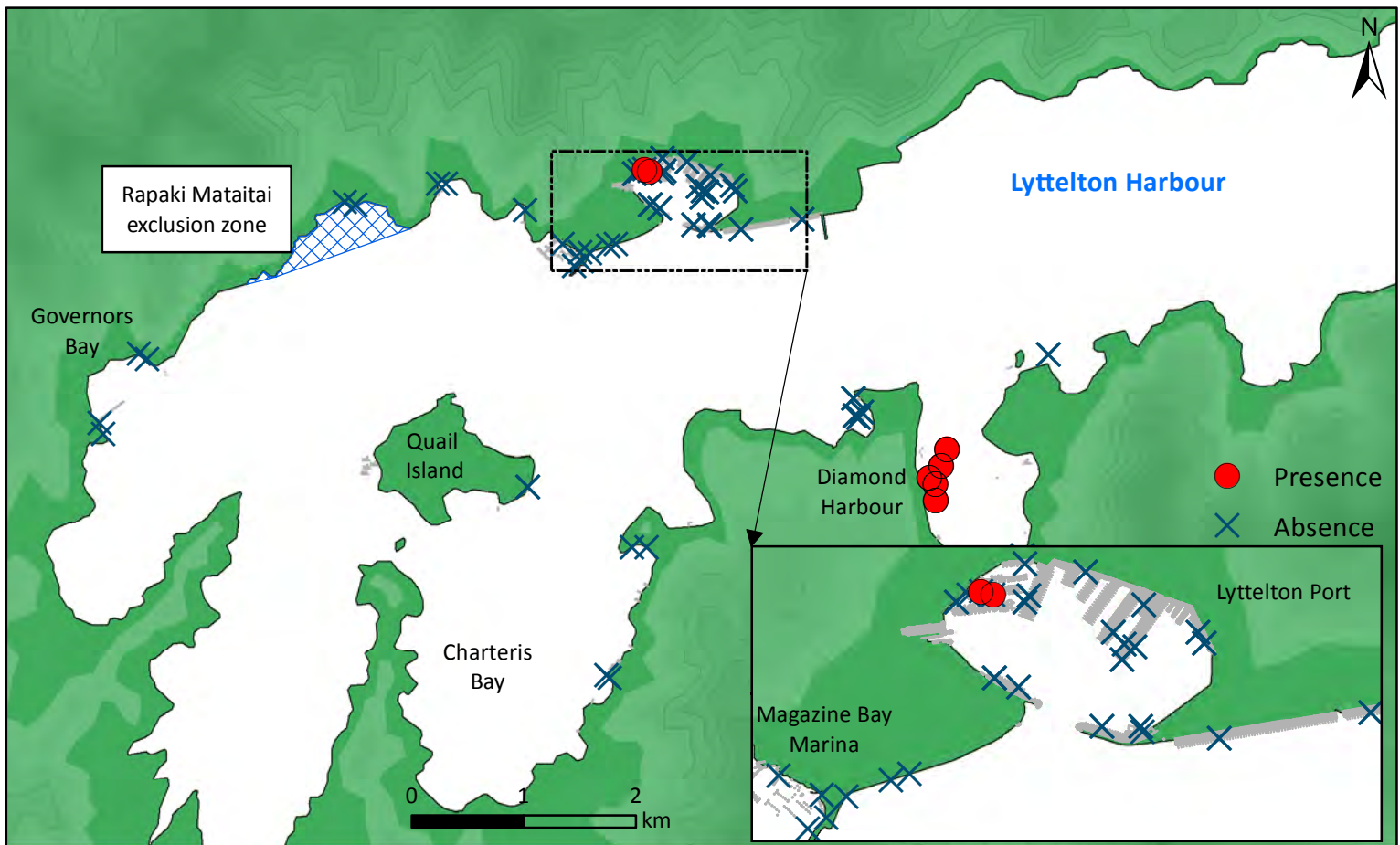
Bluff Harbour
Summer 2017-18
Undaria pinnatifida



Lyttelton Harbour/ Whakaraupō

Winter 2017

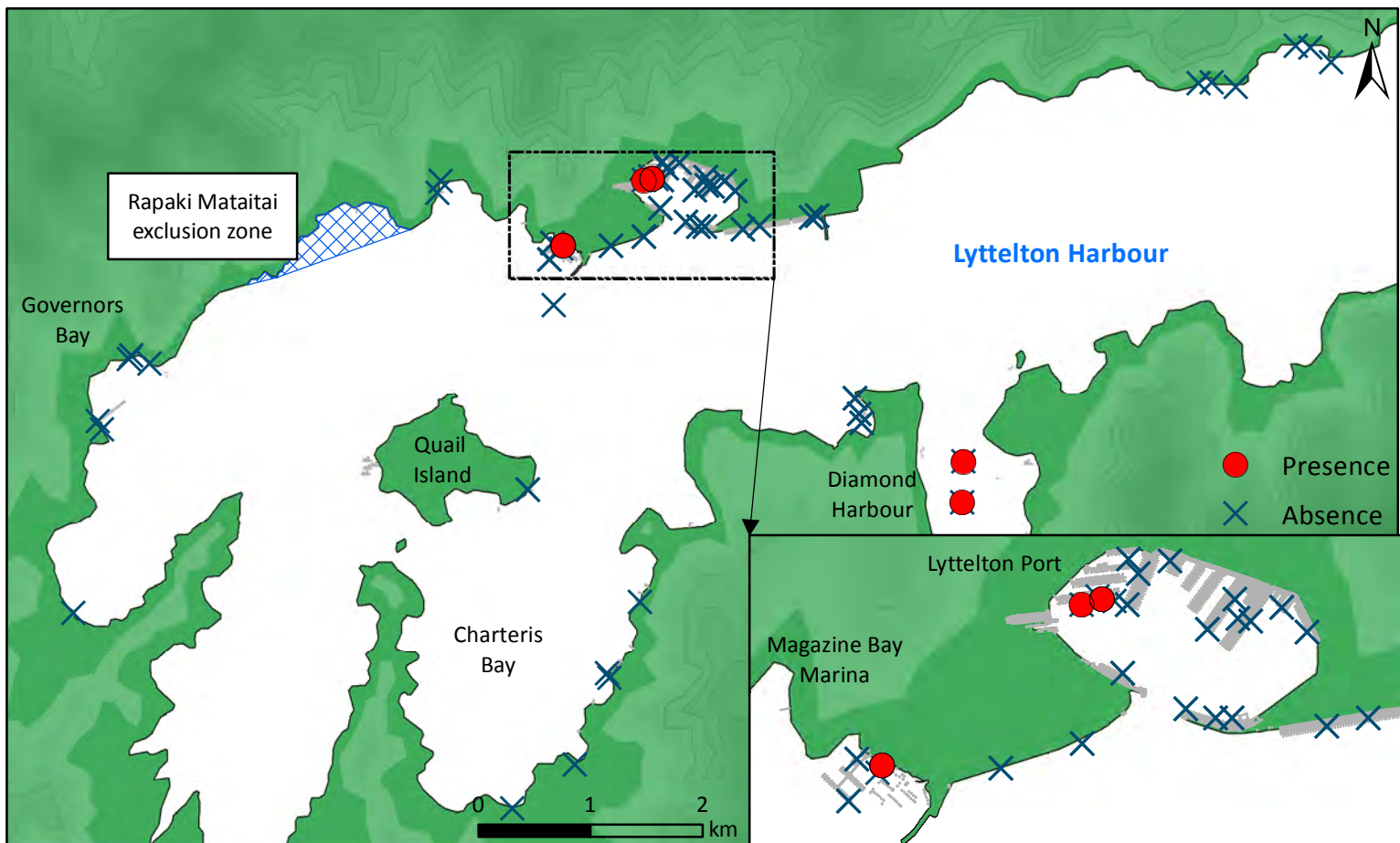
Caprella mutica



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

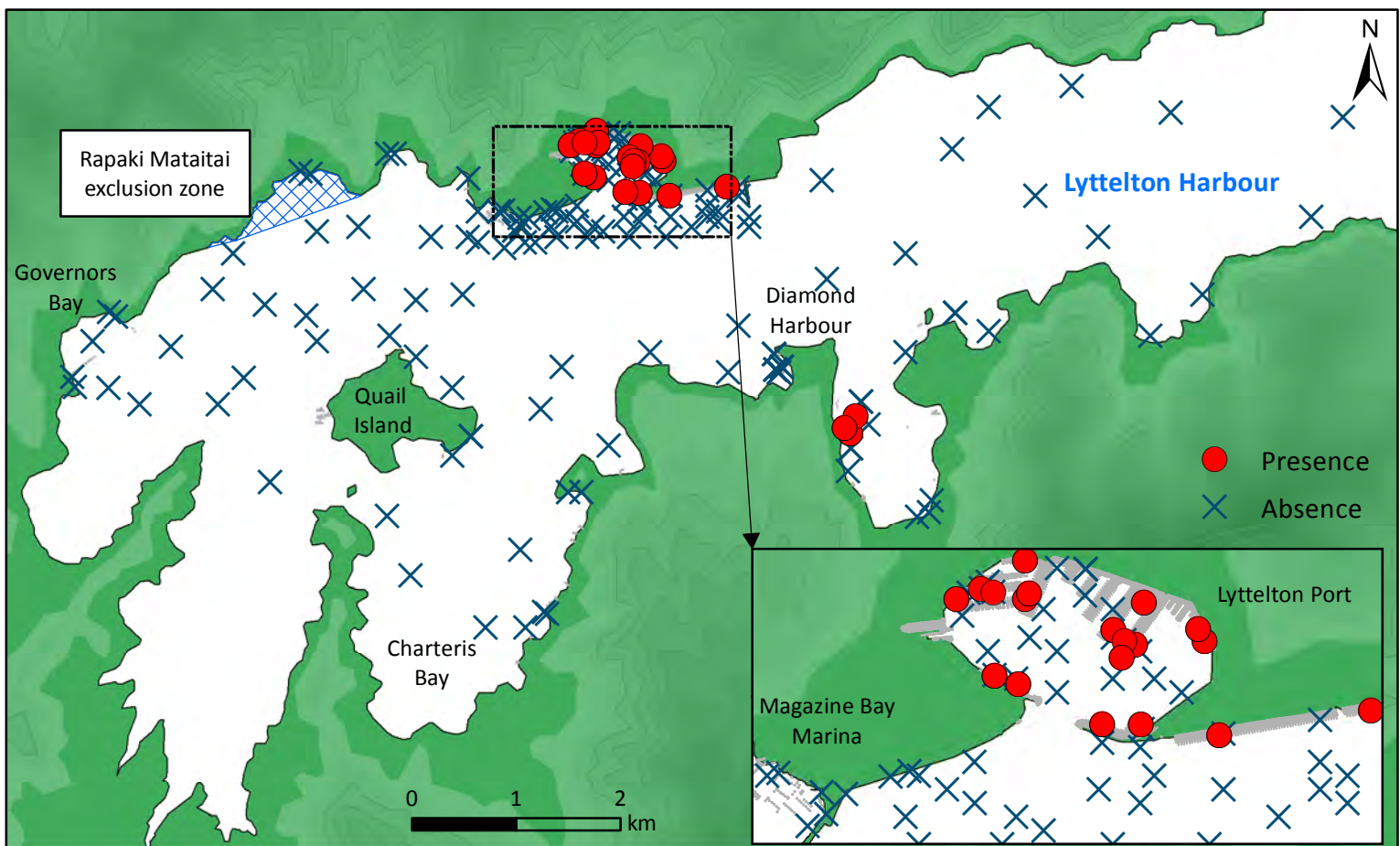
Caprella mutica



Lyttelton Harbour/ Whakaraupō

Winter 2017

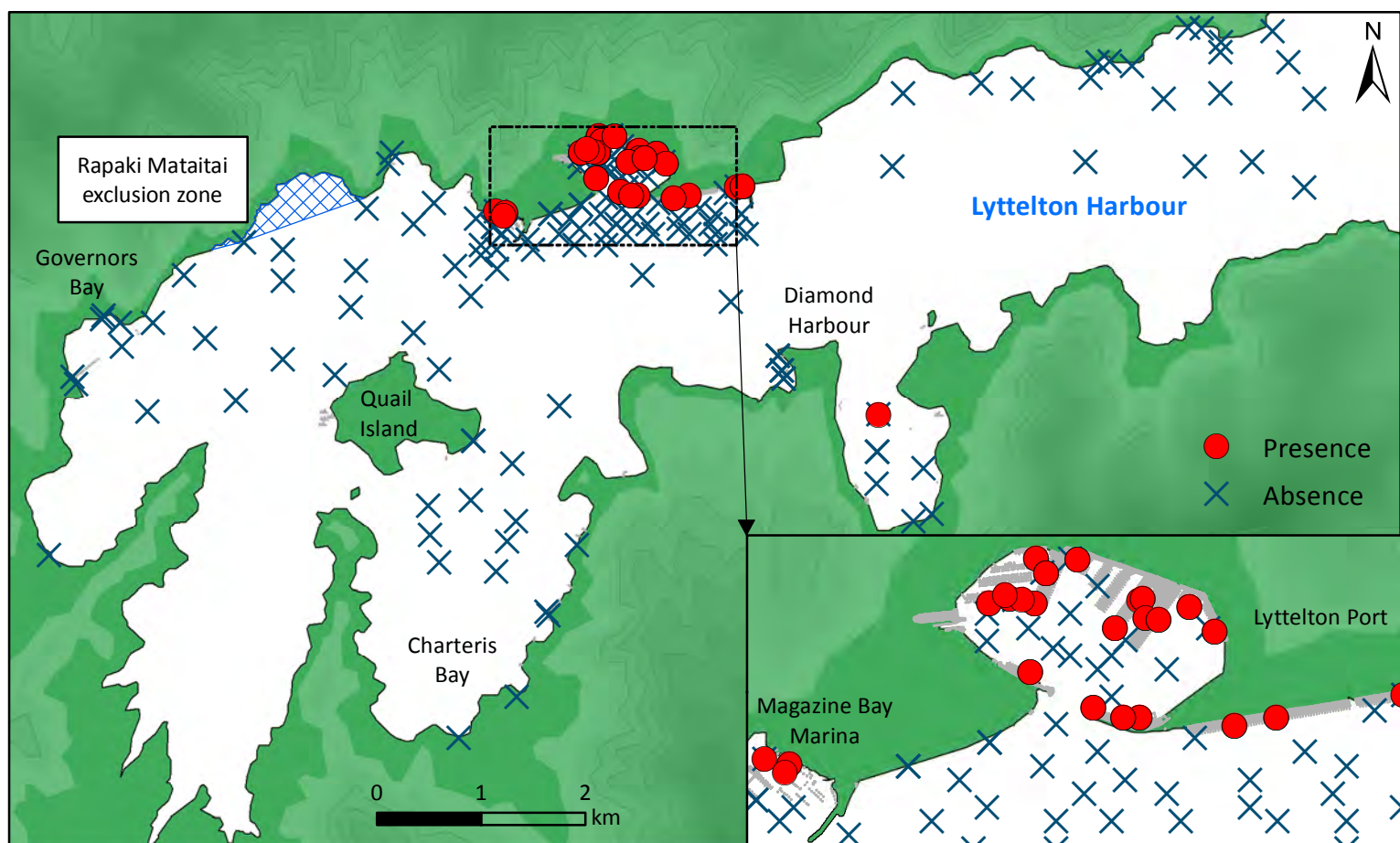
Ciona spp.



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

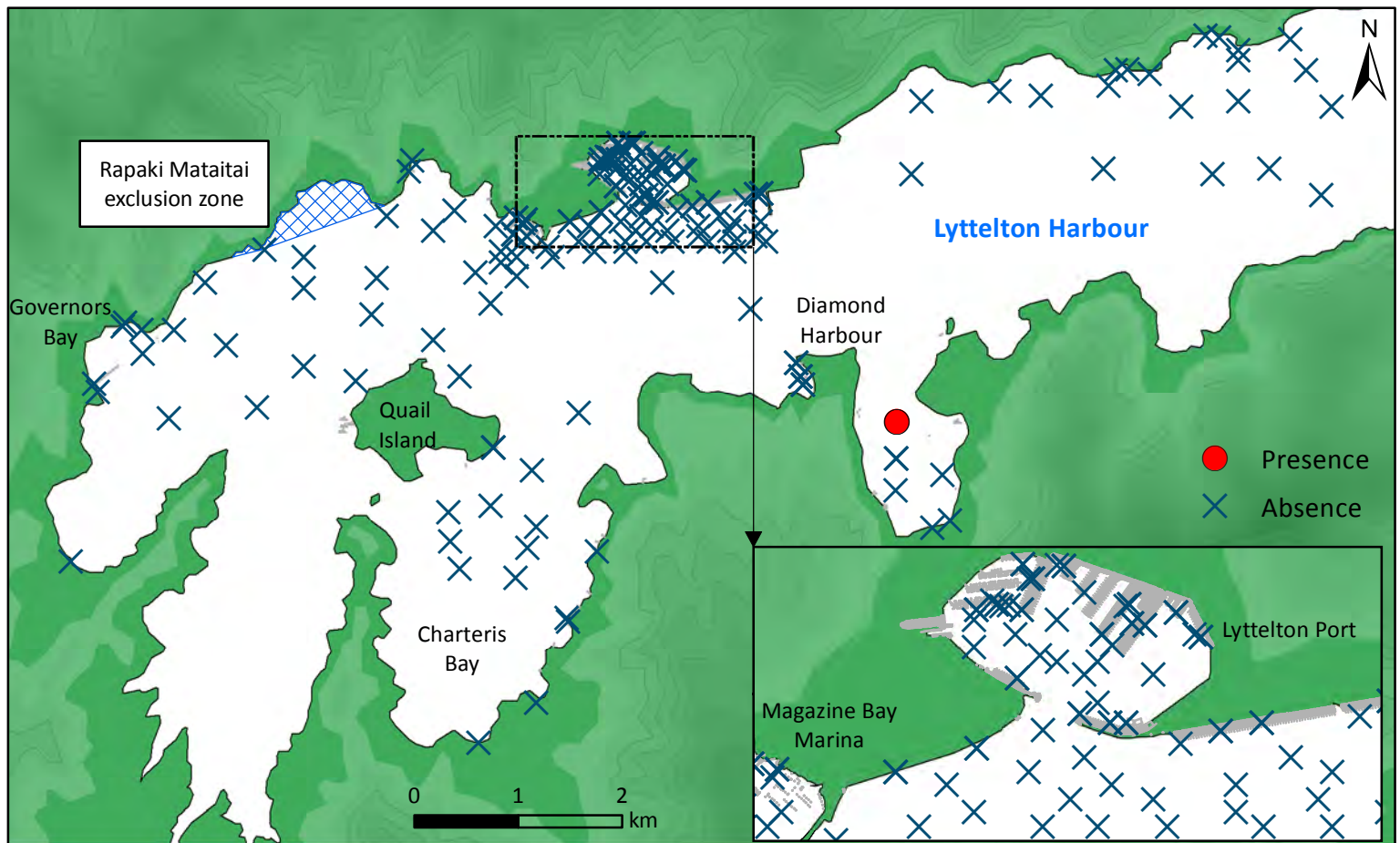
Ciona spp.



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

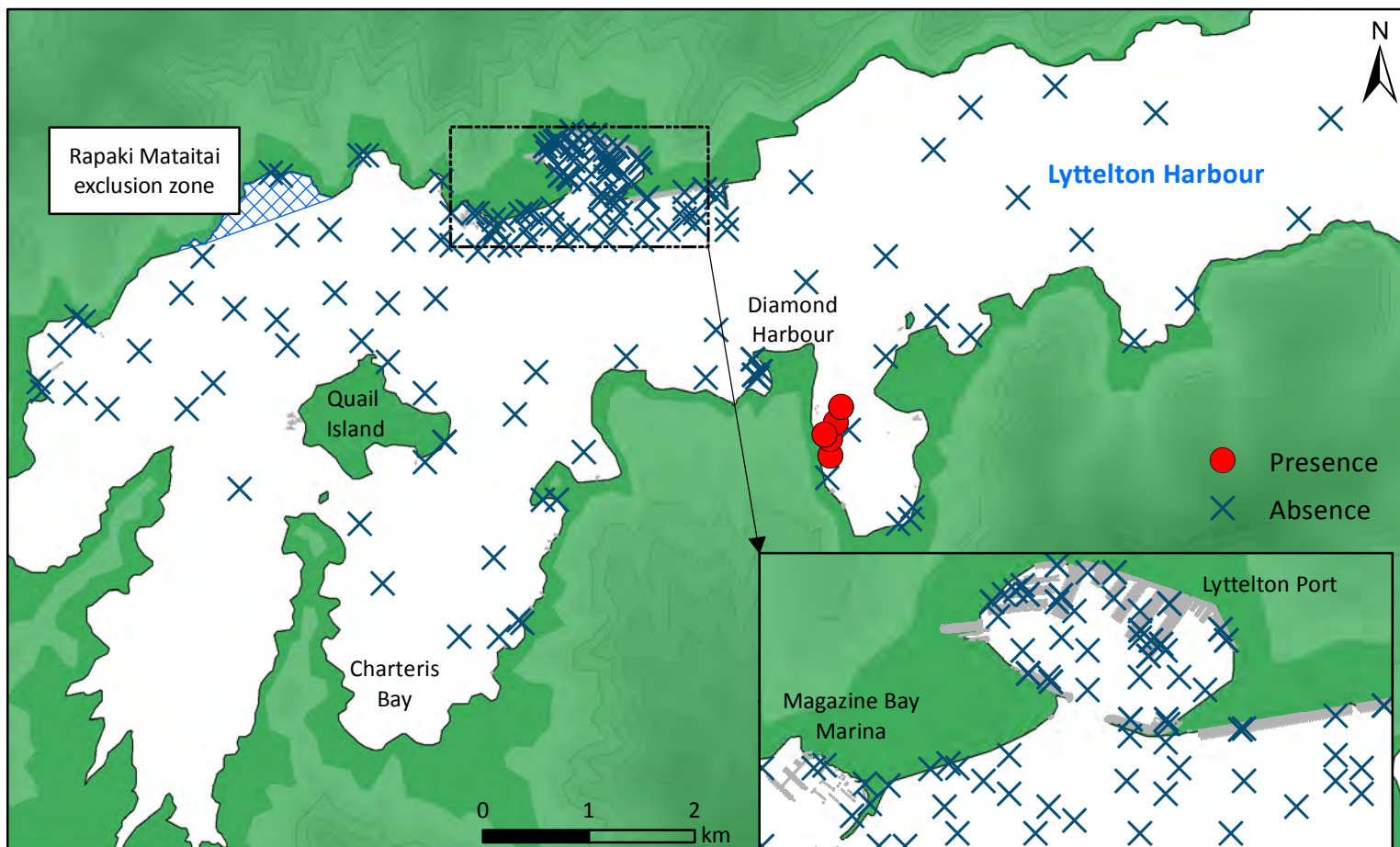
Clavelina lepadiformis



Lyttelton Harbour/ Whakaraupō

Winter 2017

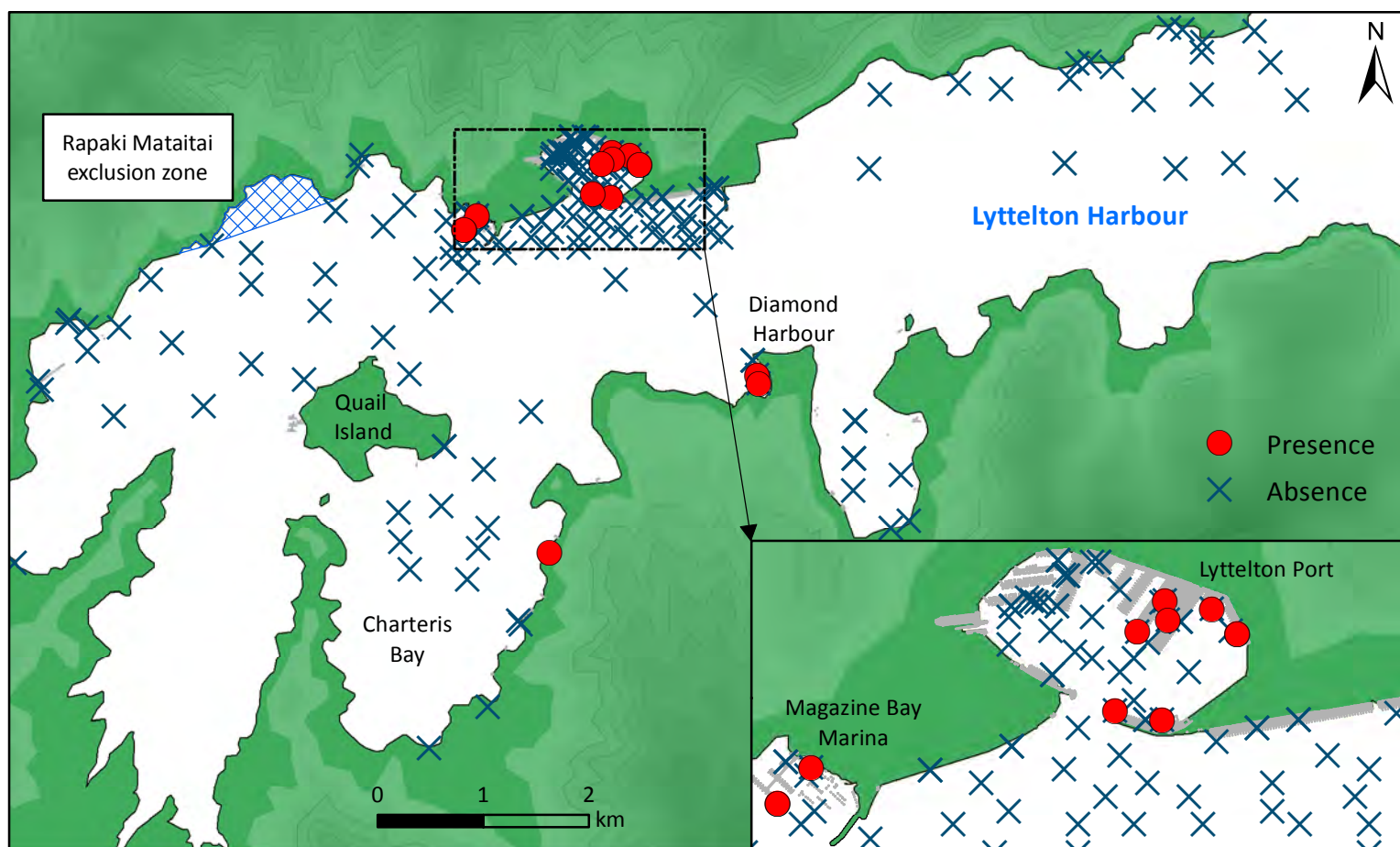
Didemnum vexillum



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

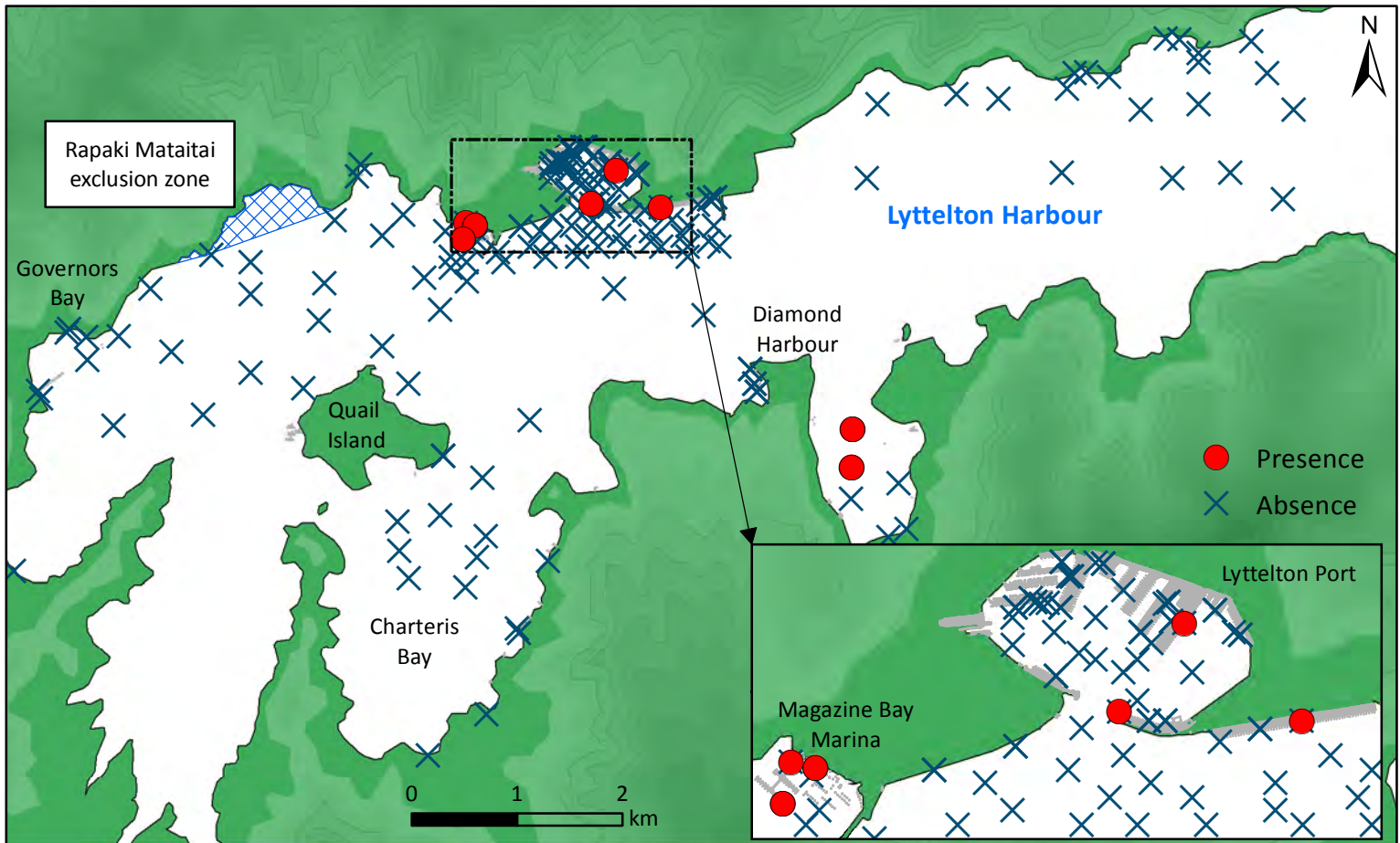
Didemnum vexillum



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

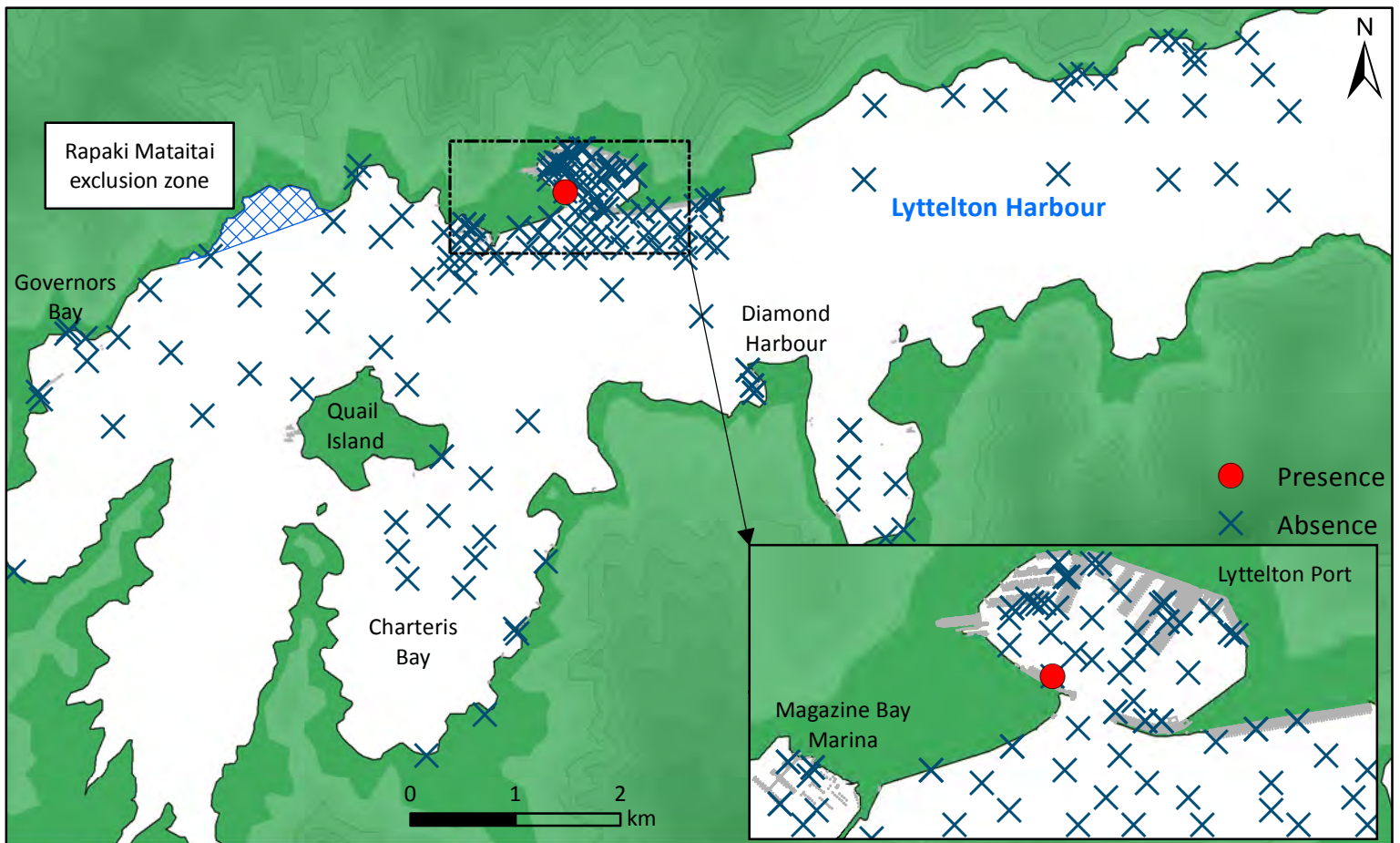
Ectopleura spp.



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

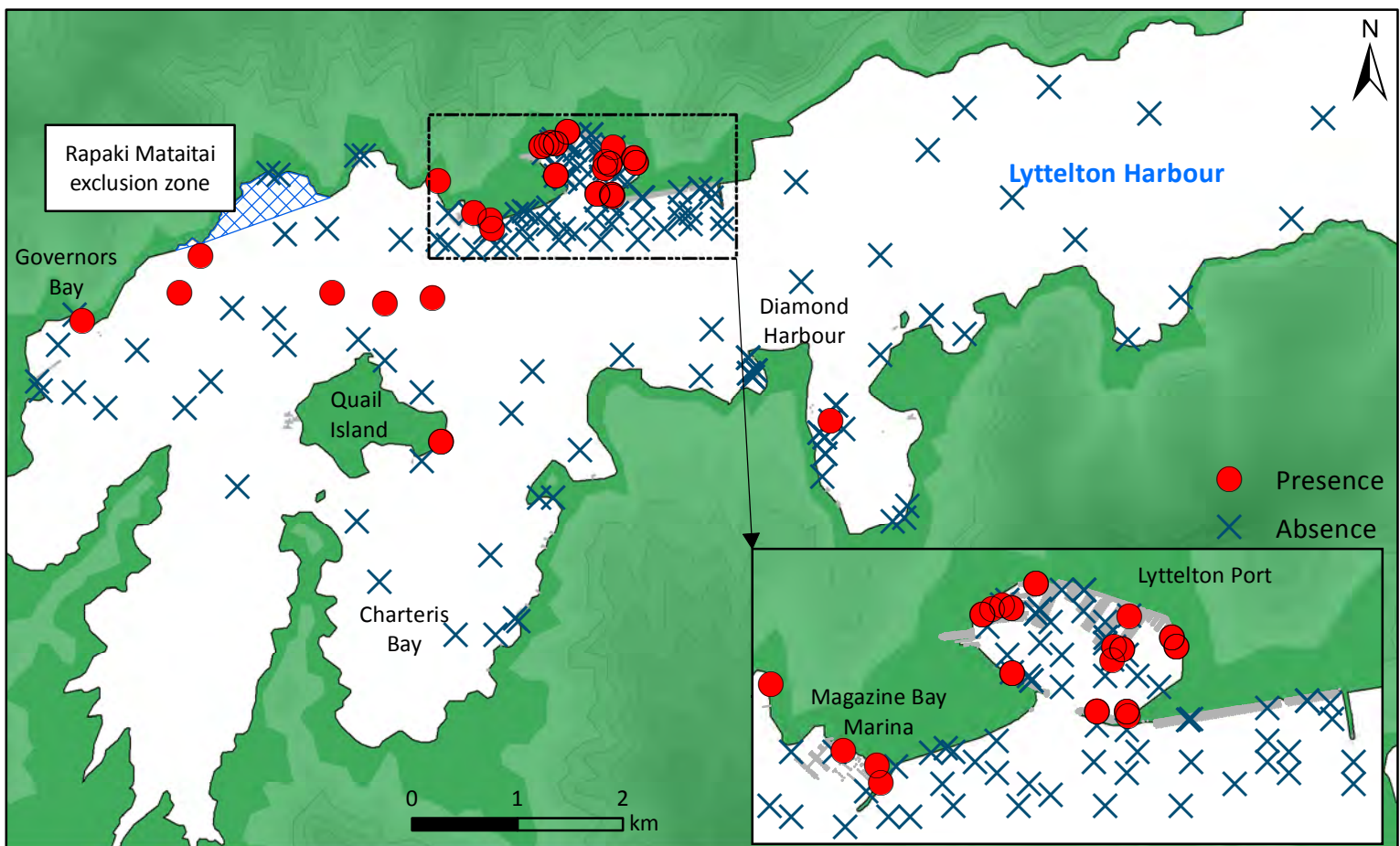
Sabella spallanzanii



Lyttelton Harbour/ Whakaraupō

Winter 2017

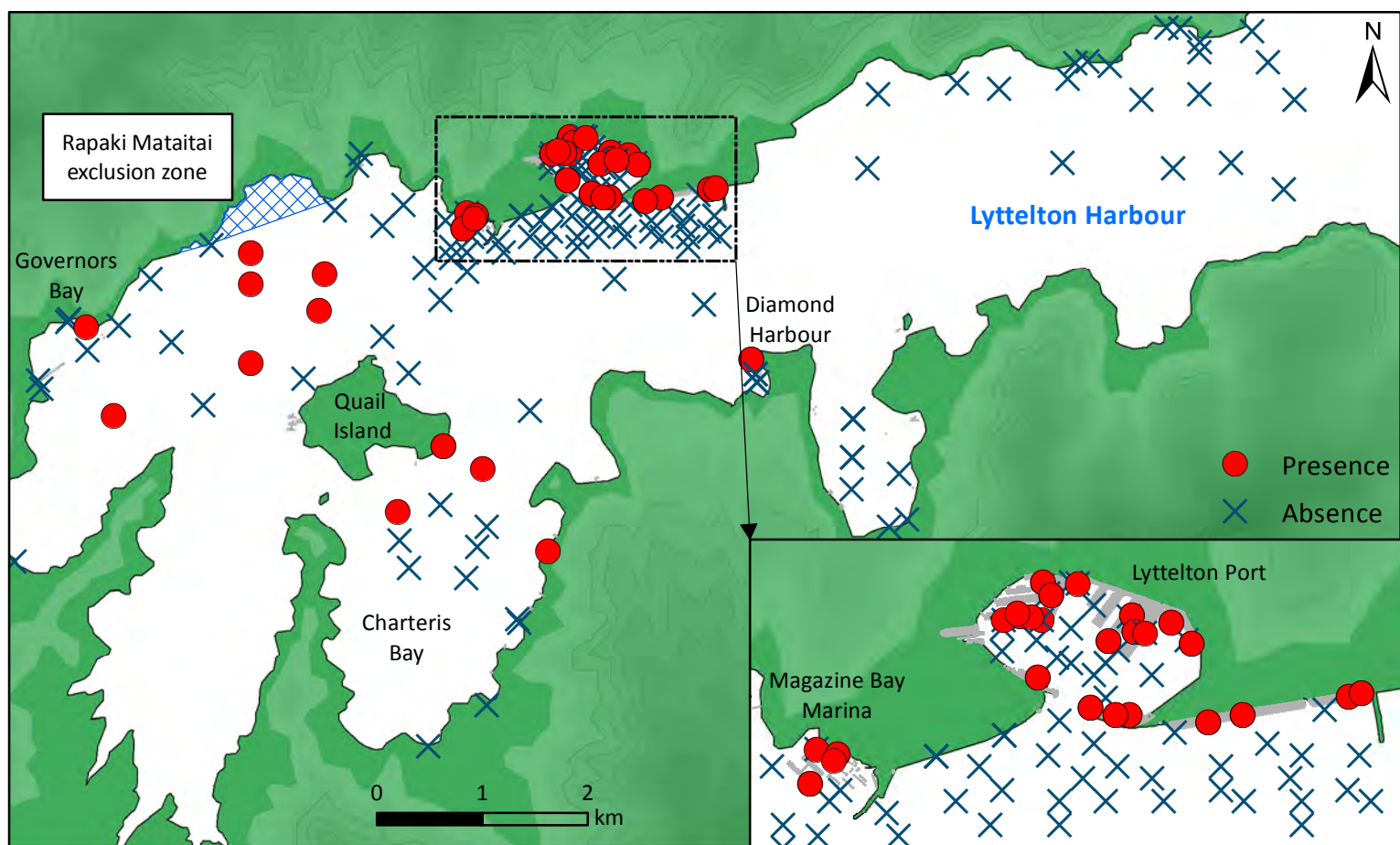
Styela clava



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

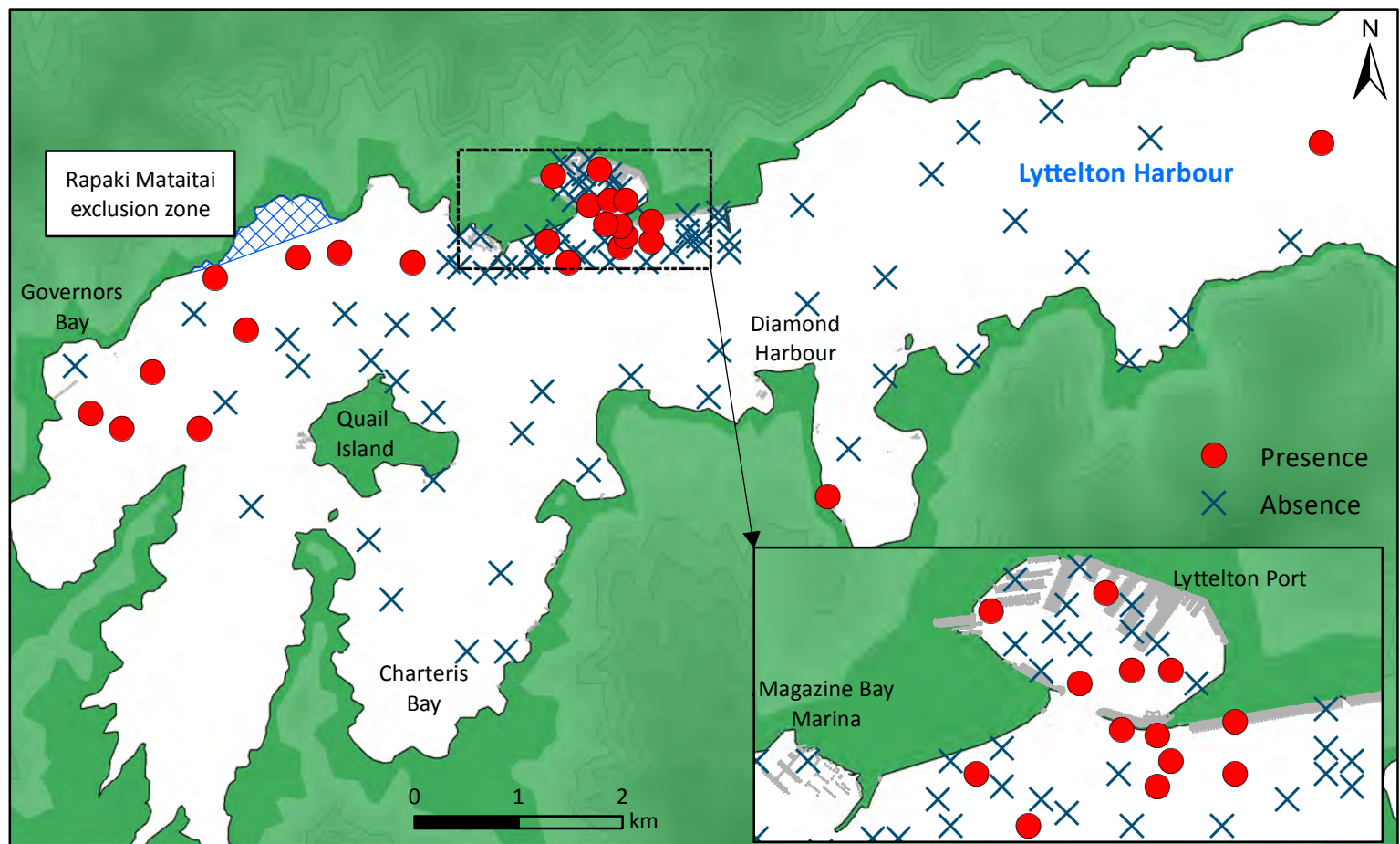
Styela clava



Lyttelton Harbour/ Whakaraupō

Winter 2017

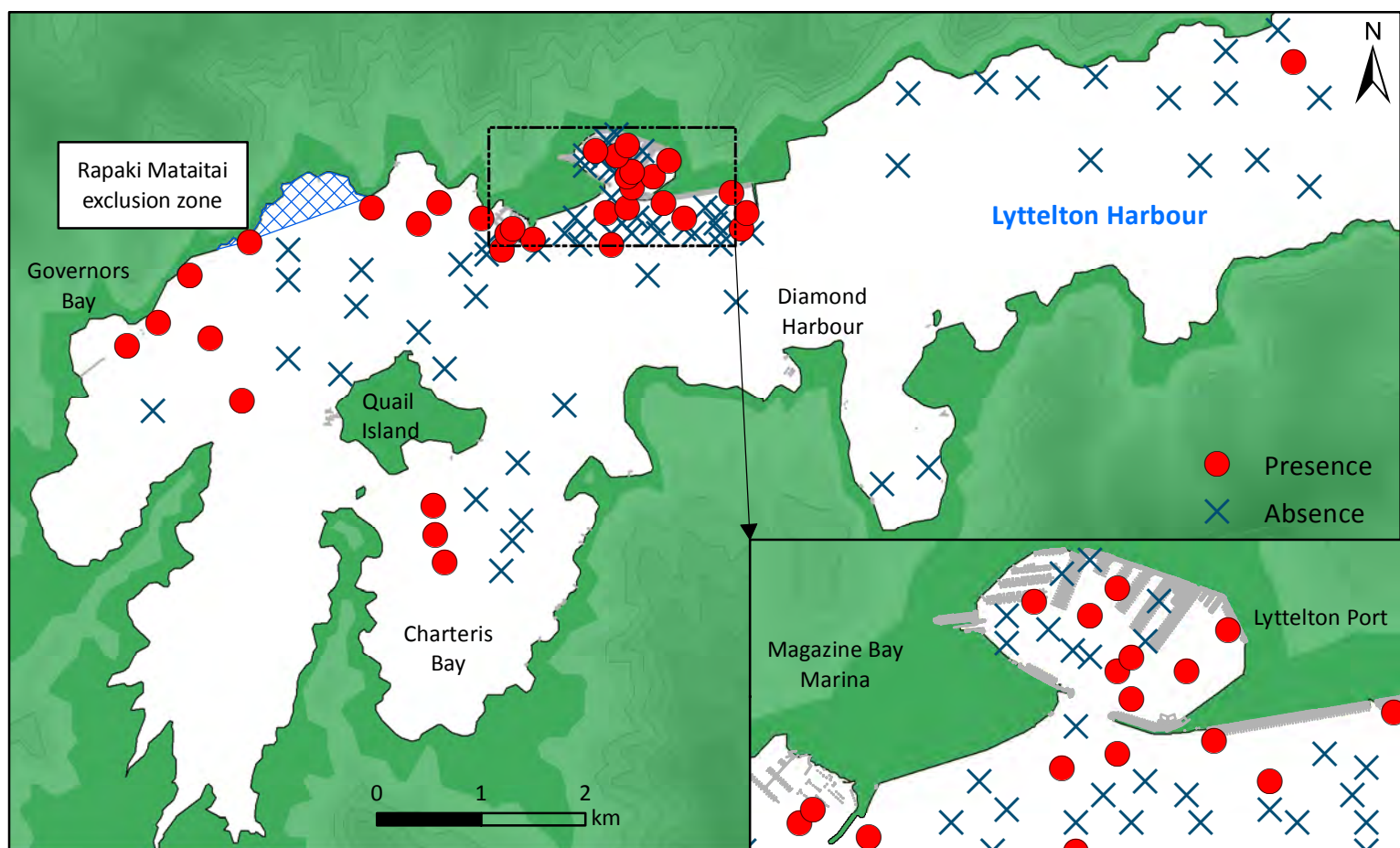
Theora lubrica



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

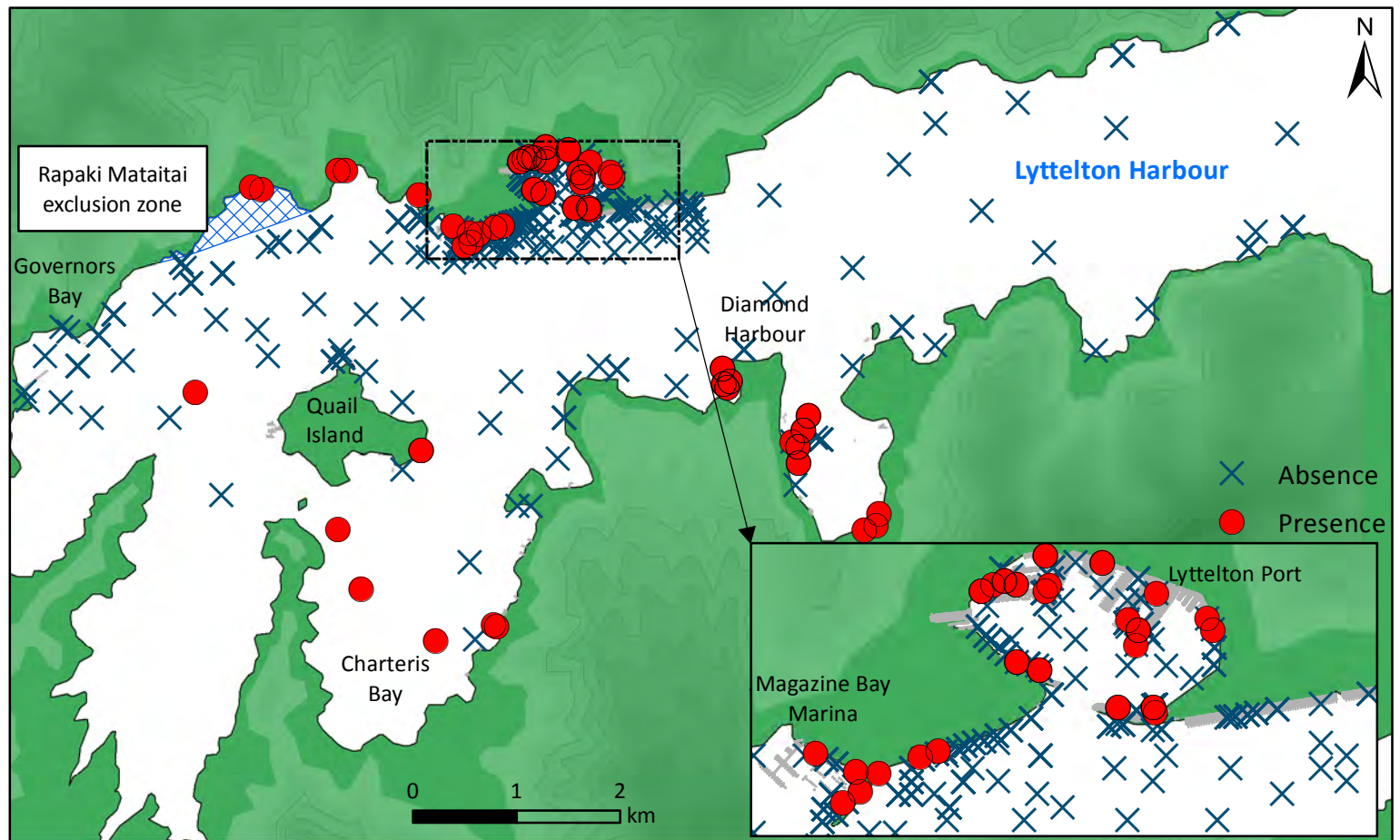
Theora lubrica



Lyttelton Harbour/ Whakaraupō

Winter 2017

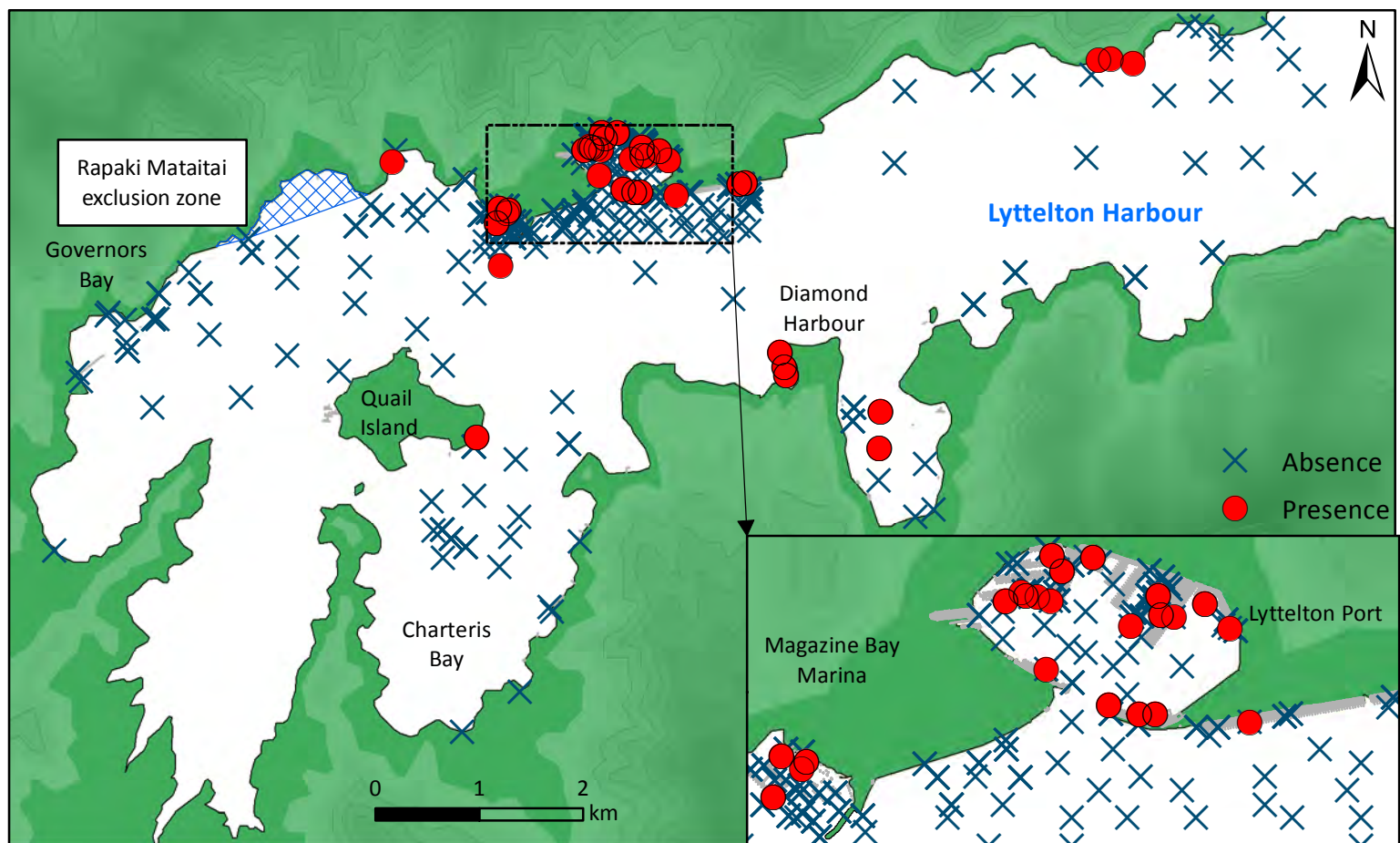
Undaria pinnatifida



Lyttelton Harbour/ Whakaraupō

Summer 2017-18

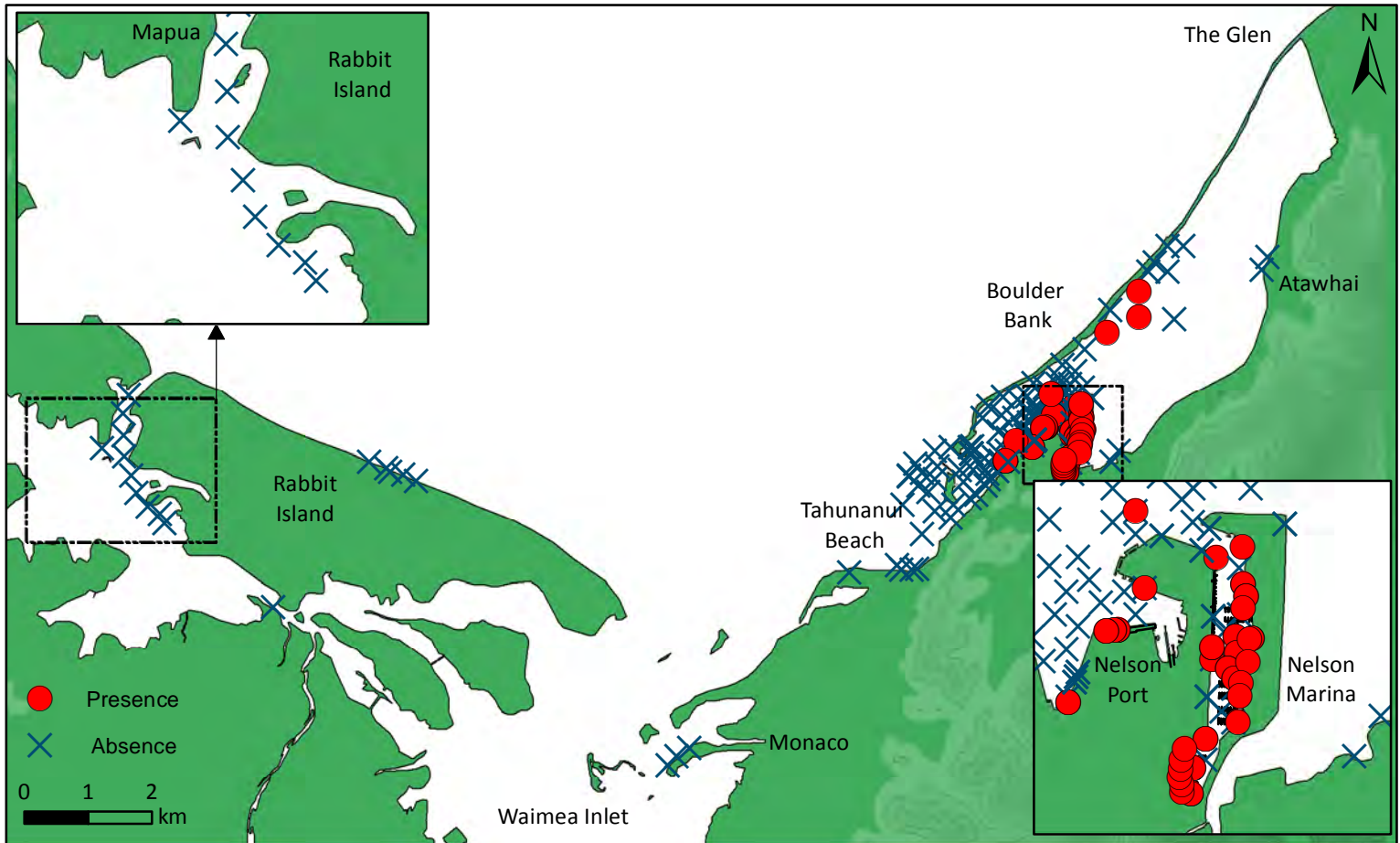
Undaria pinnatifida



Nelson Harbour and Waimea Inlet

Summer 2017-18

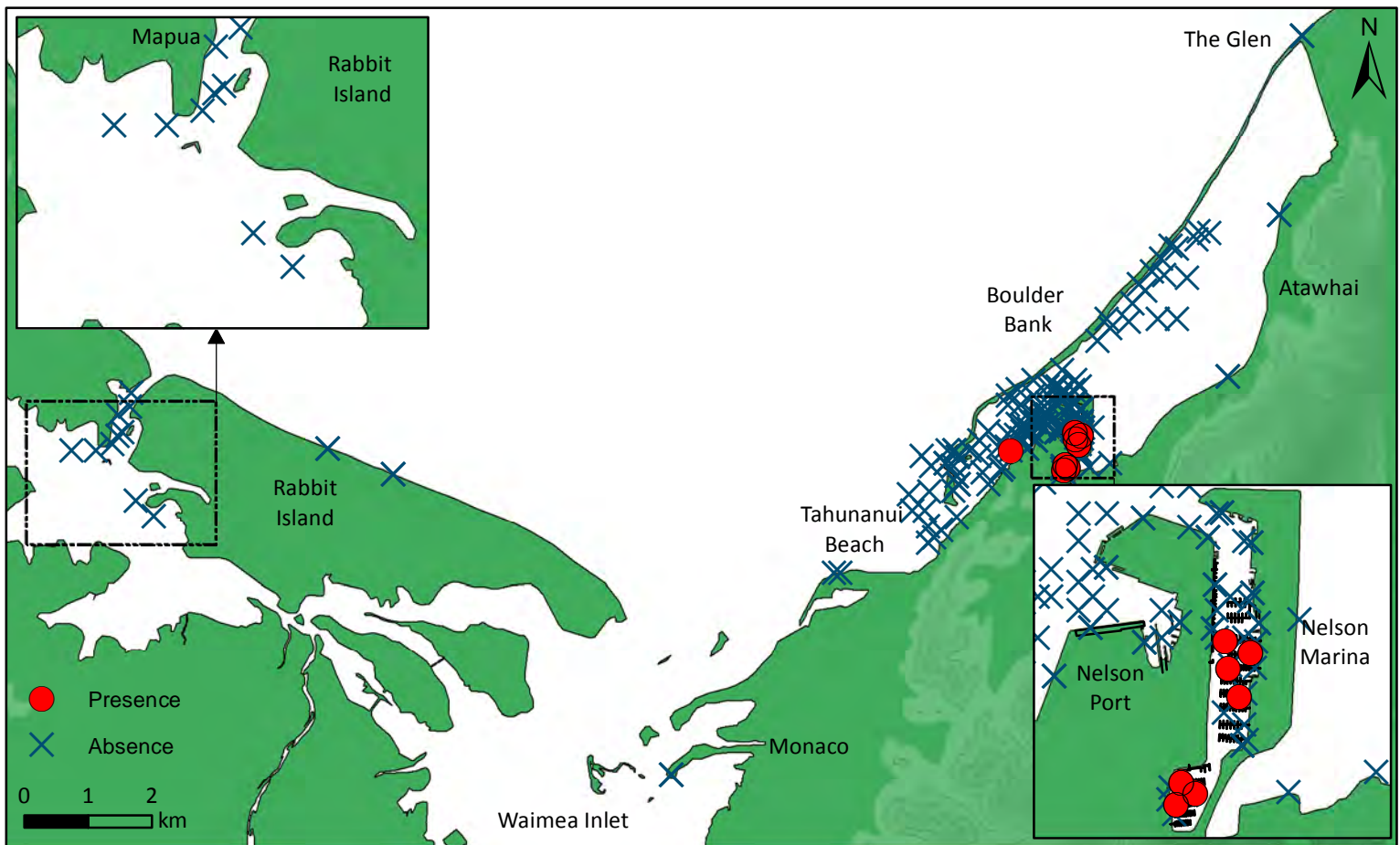
Amathia verticillata



Nelson Harbour and Waimea Inlet

Winter 2017

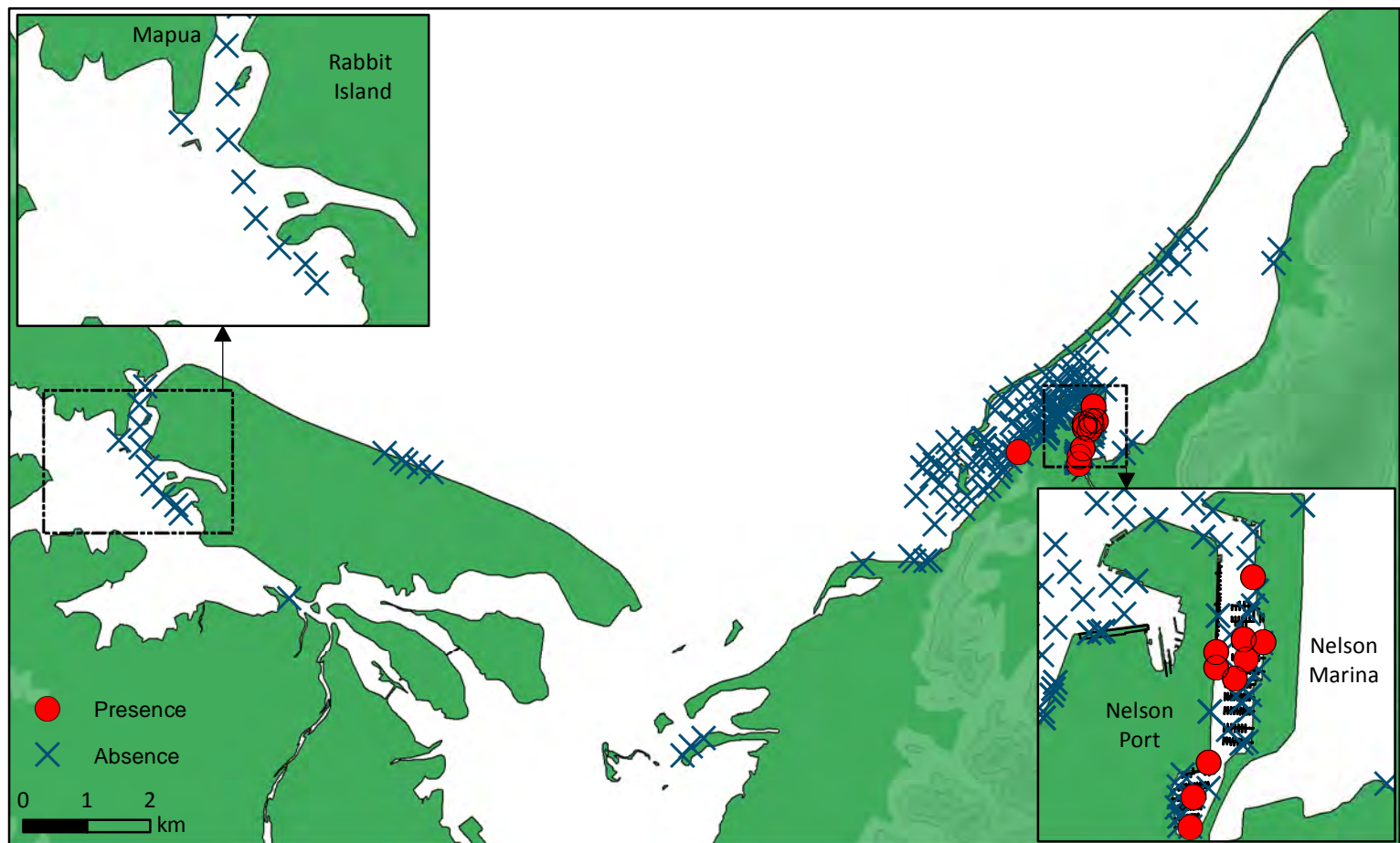
Ciona spp.



Nelson Harbour and Waimea Inlet

Summer 2017-18

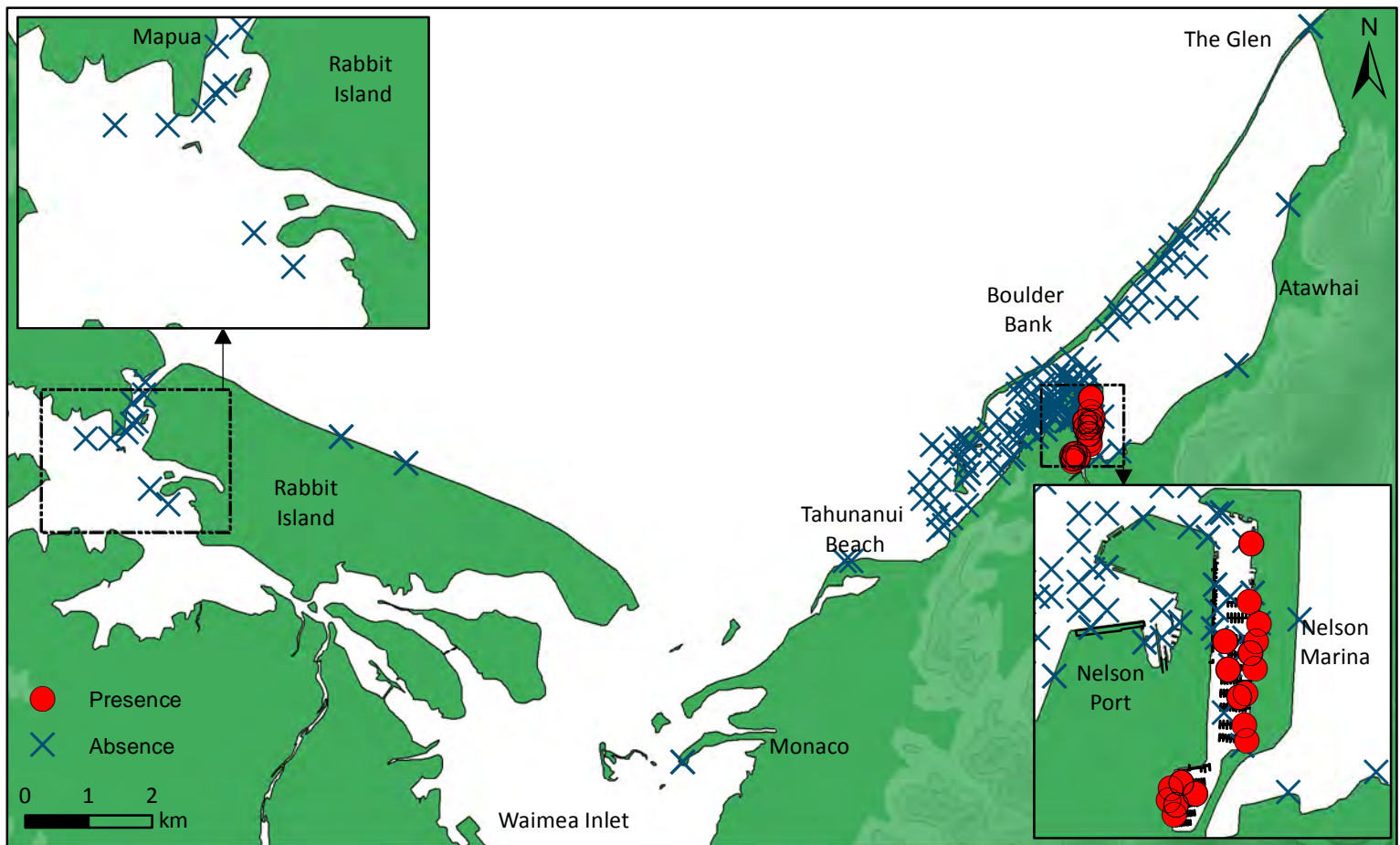
Ciona spp.



Nelson Harbour and Waimea Inlet

Winter 2017

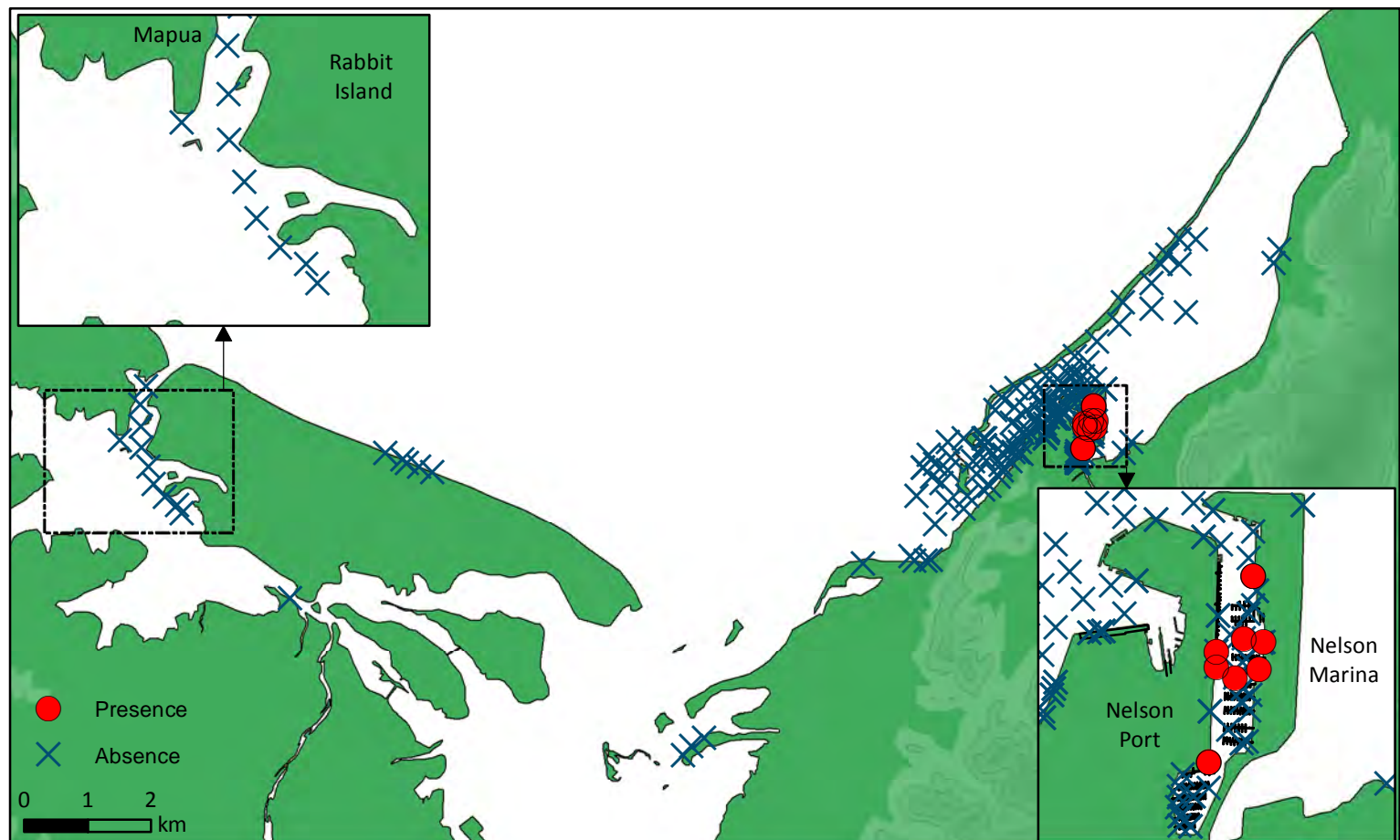
Clavelina lepadiformis



Nelson Harbour and Waimea Inlet

Summer 2017-18

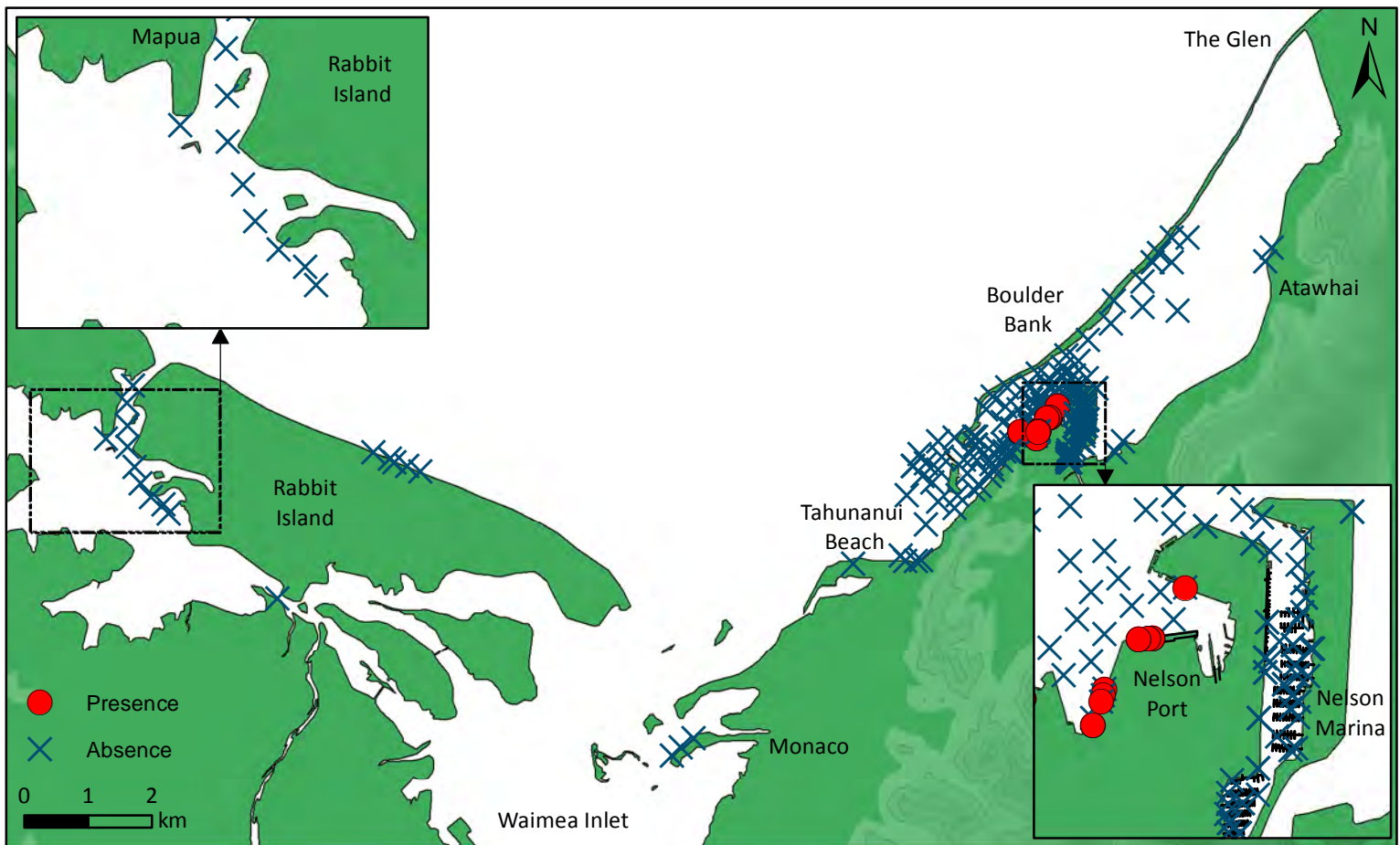
Clavelina lepadiformis



Nelson Harbour and Waimea Inlet

Summer 2017-18

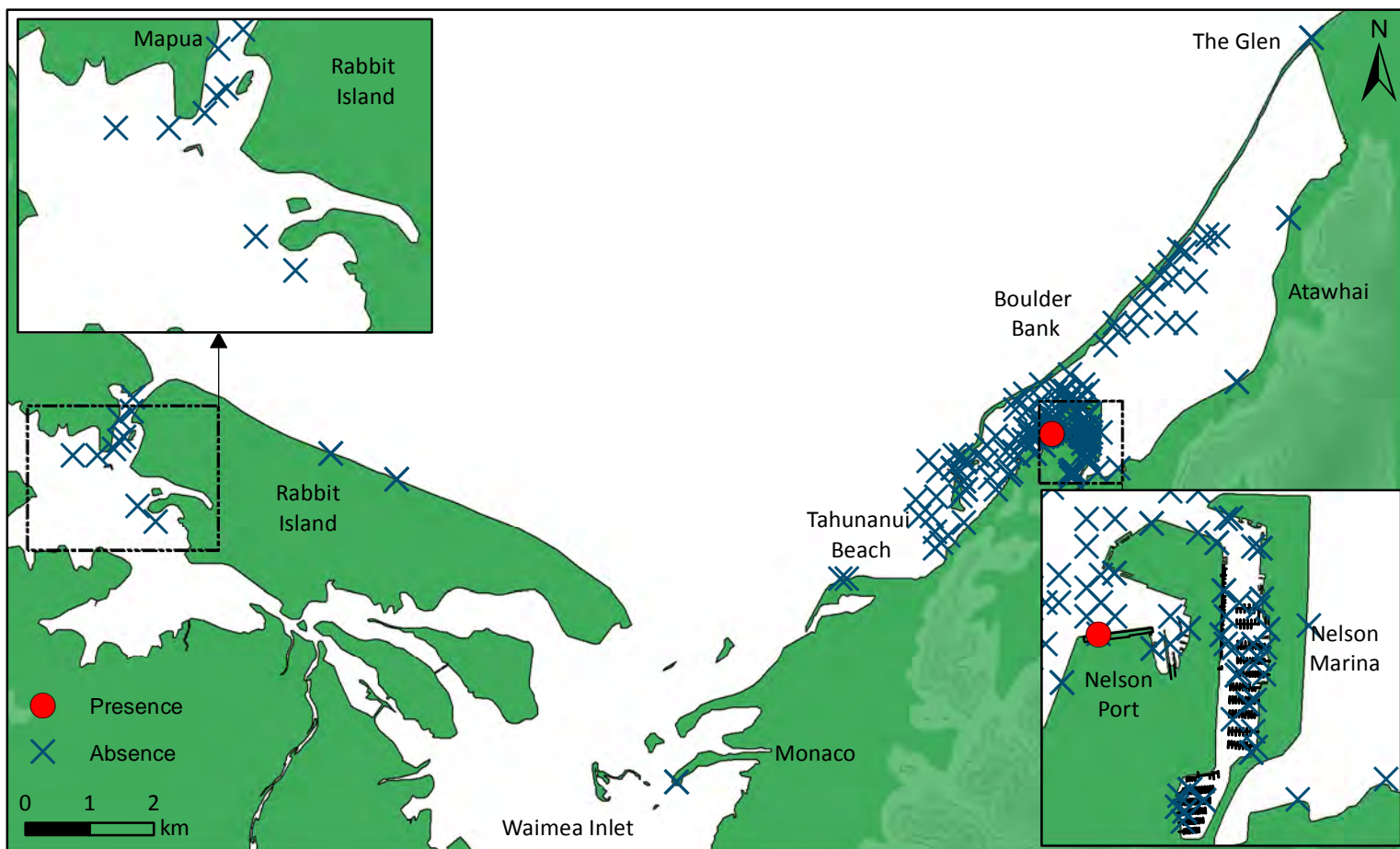
Didemnum vexillum



Nelson Harbour and Waimea Inlet

Winter 2017

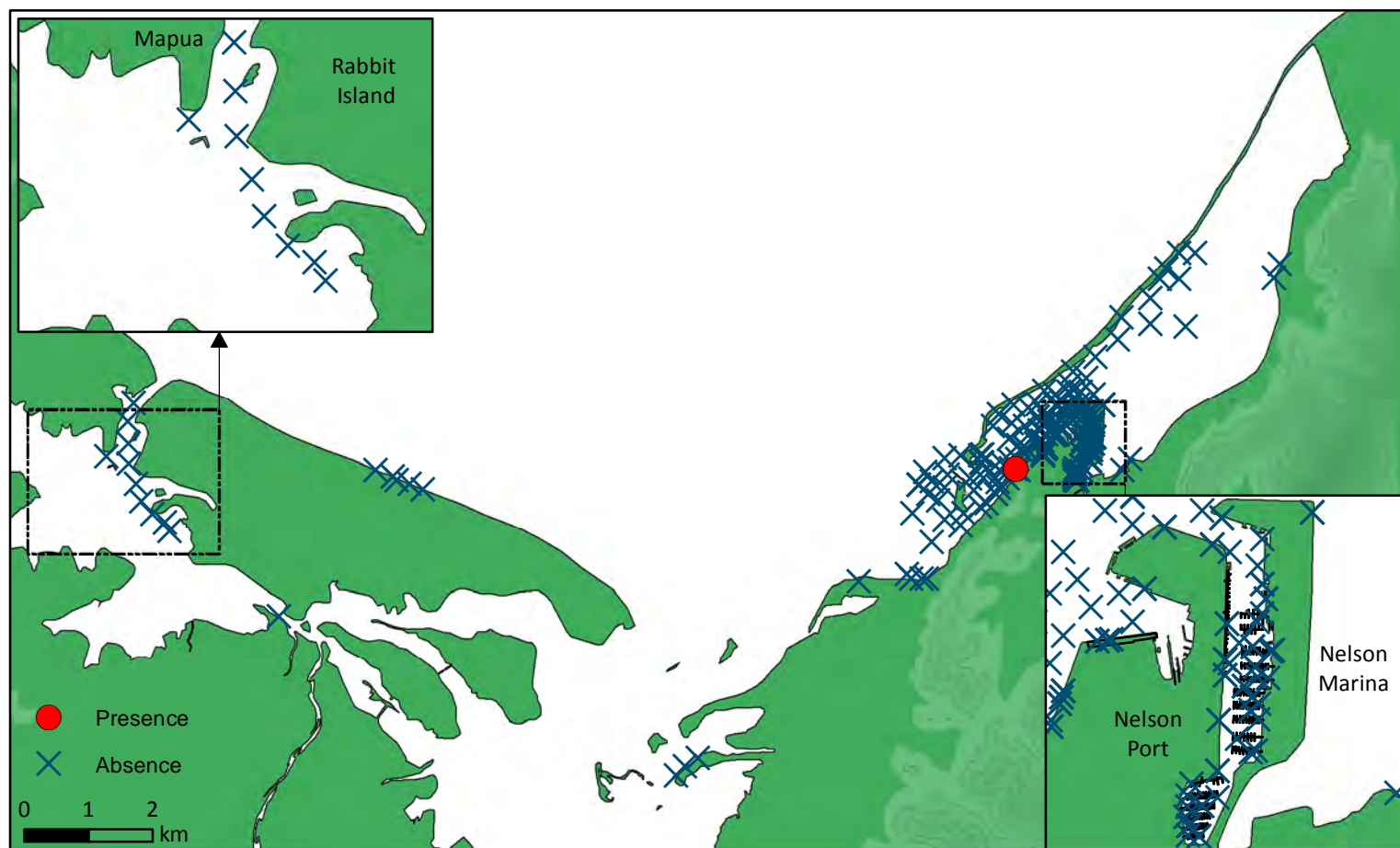
Ectopleura spp.



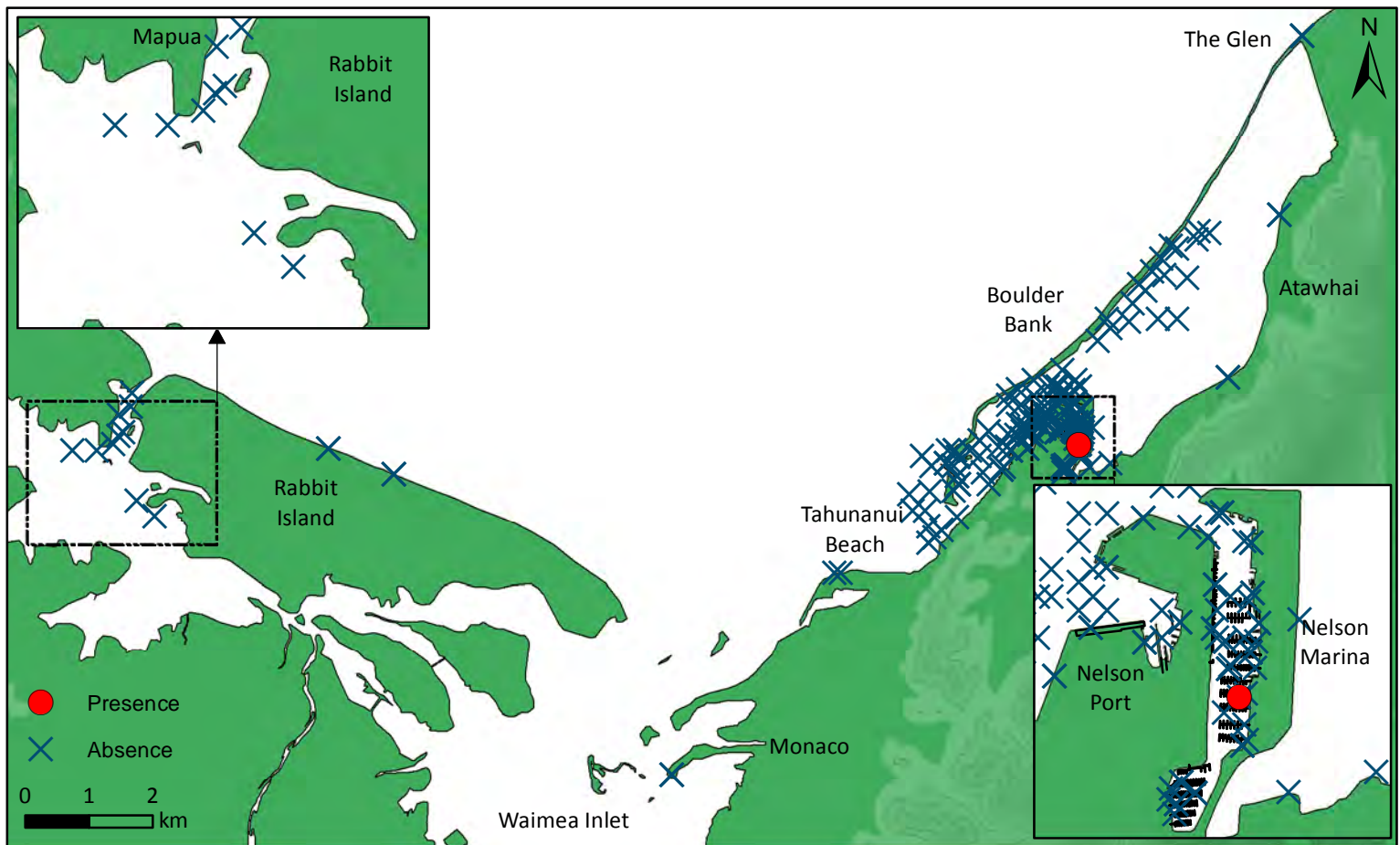
Nelson Harbour and Waimea Inlet

Summer 2017-18

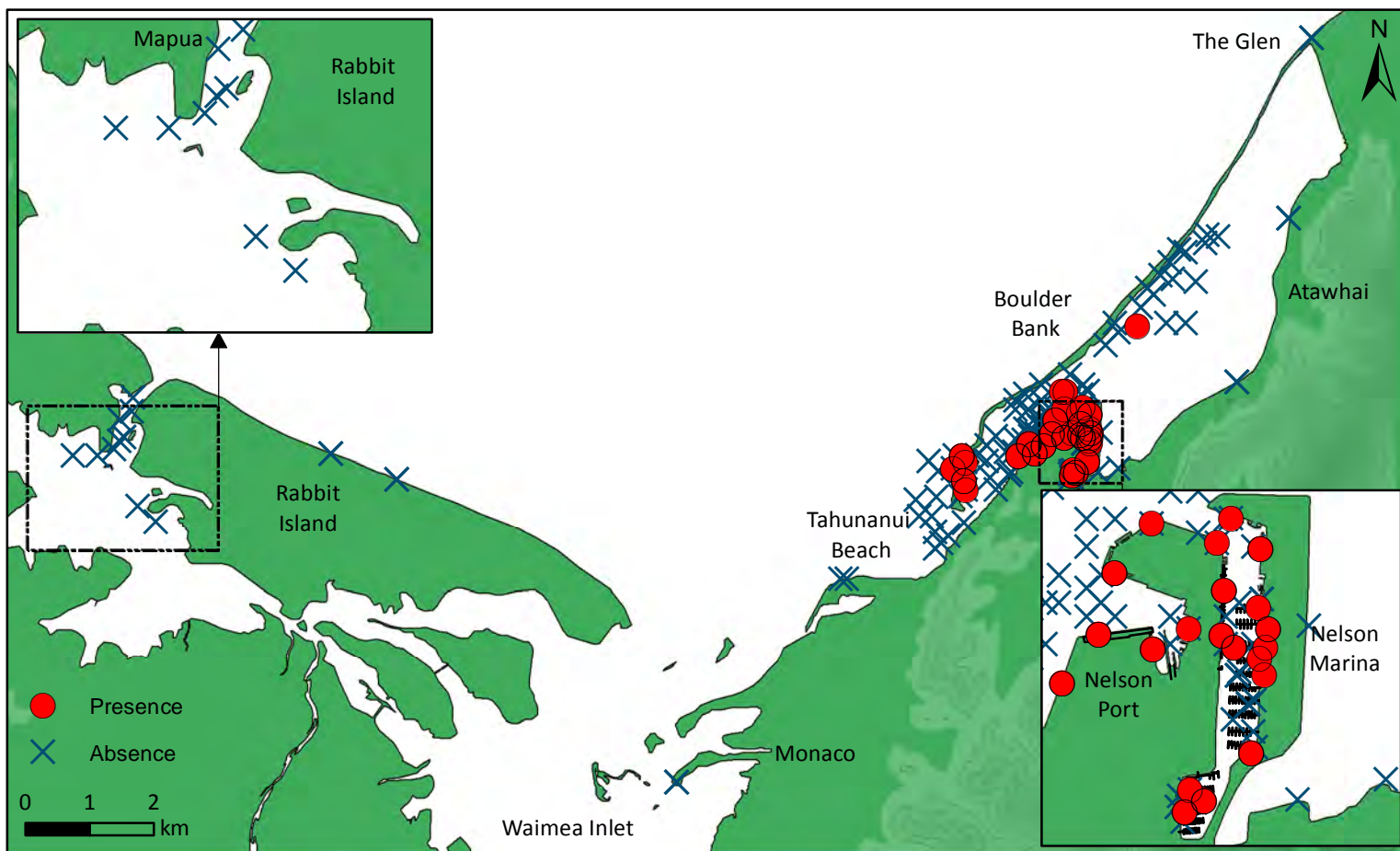
Ectopleura spp.



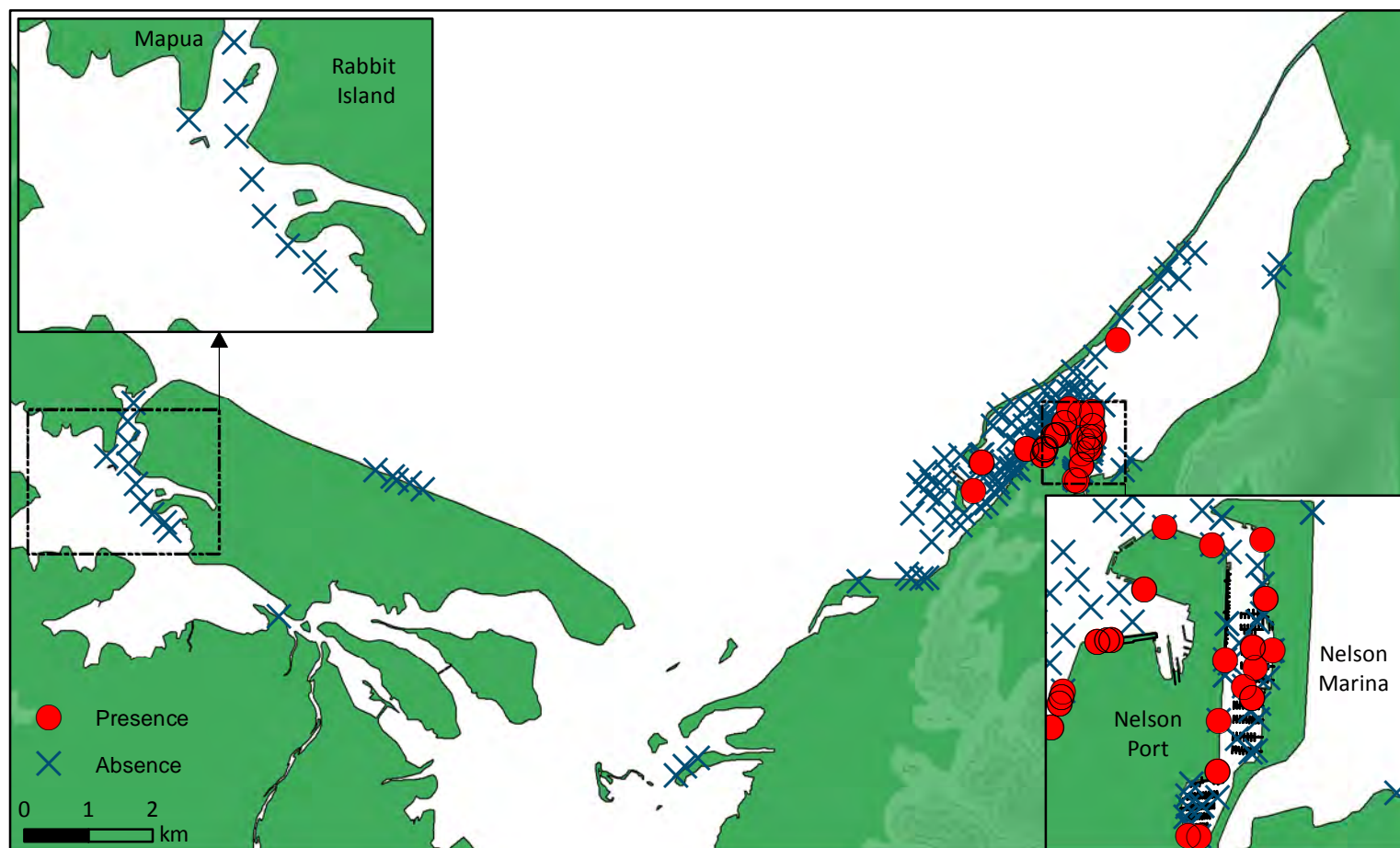
Nelson Harbour and Waimea Inlet
Winter 2017
Grateloupia turuturu



Nelson Harbour and Waimea Inlet
Winter 2017
Styela clava



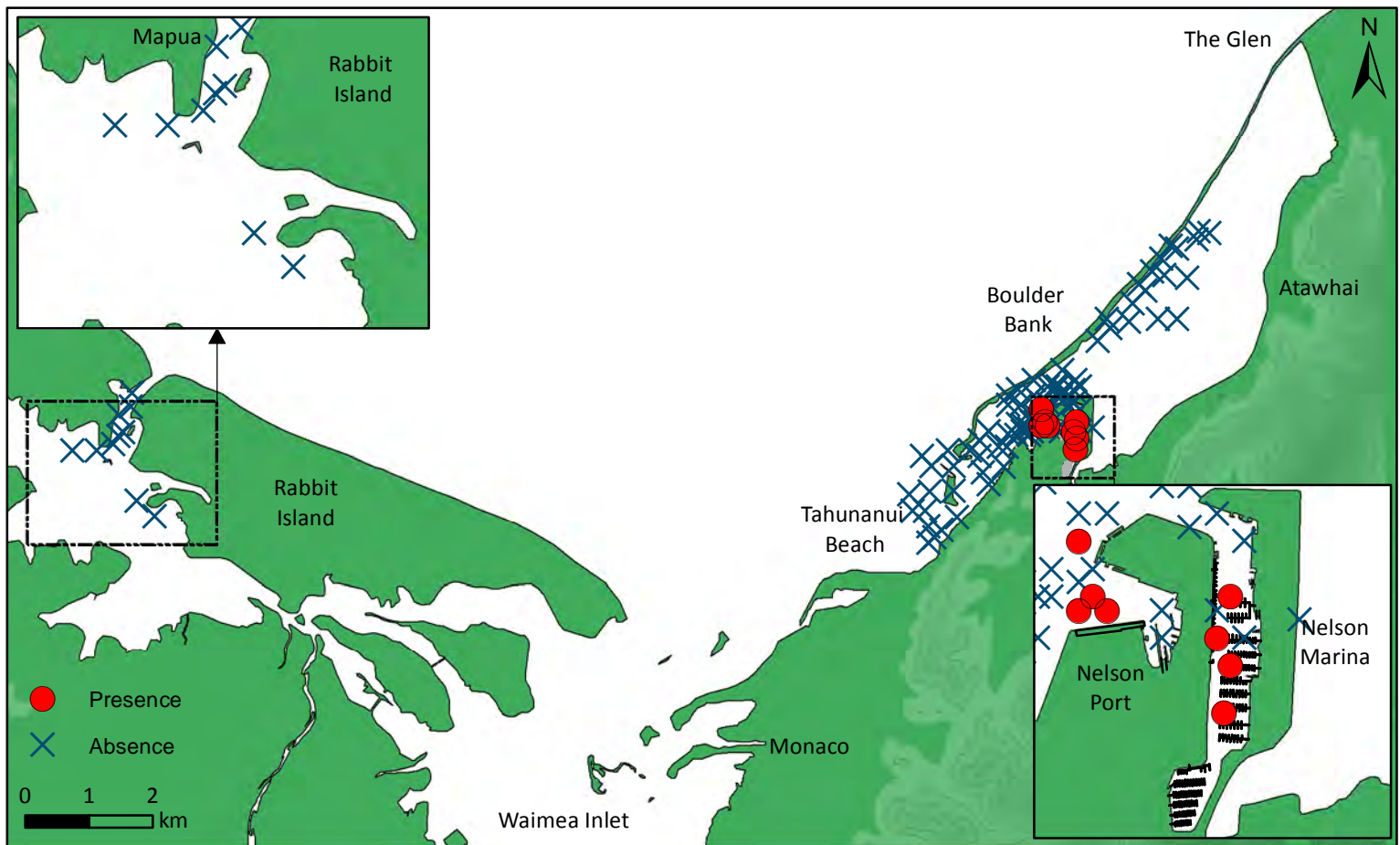
Nelson Harbour and Waimea Inlet
Summer 2017-18
Styela clava



Nelson Harbour and Waimea Inlet

Winter 2017

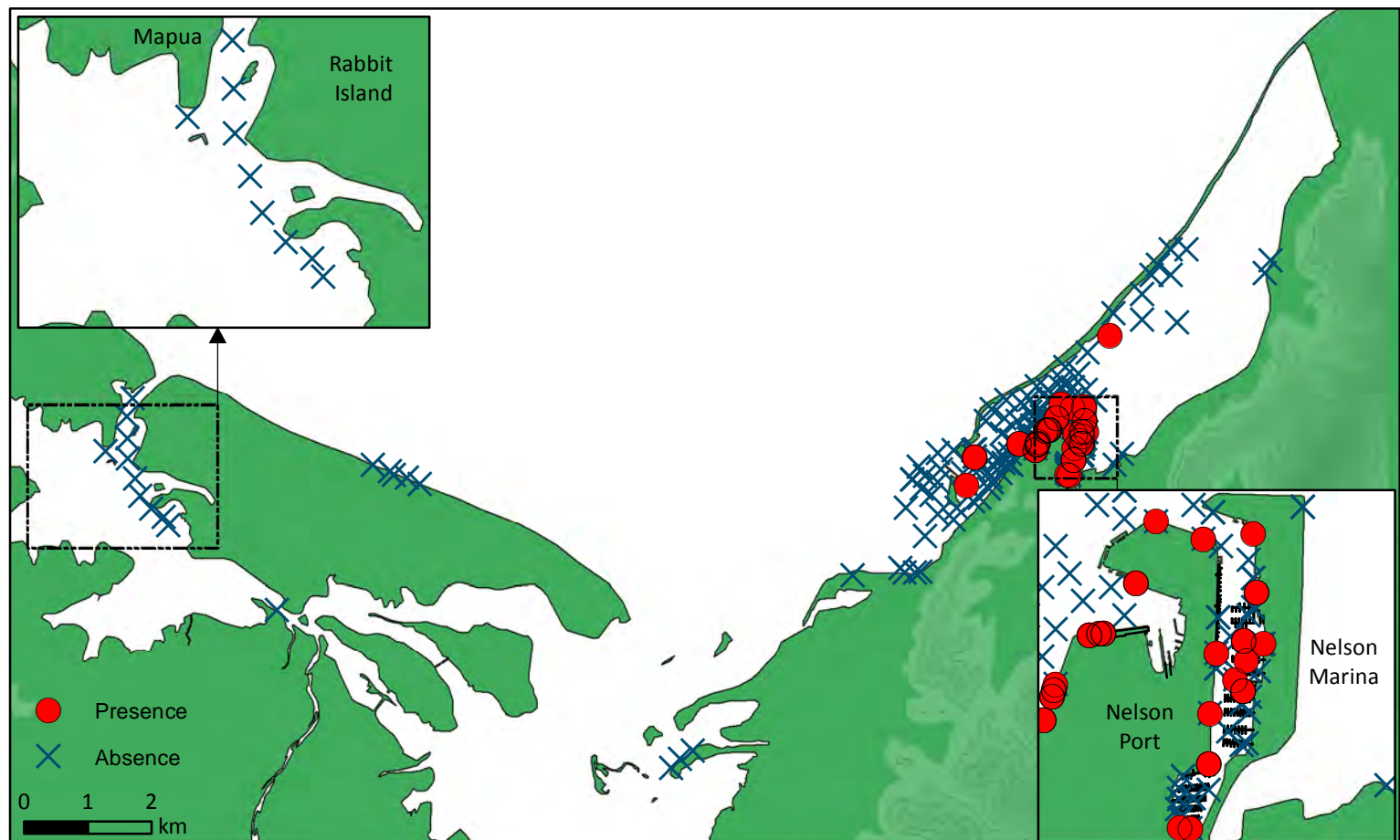
Theora lubrica



Nelson Harbour and Waimea Inlet

Summer 2017-18

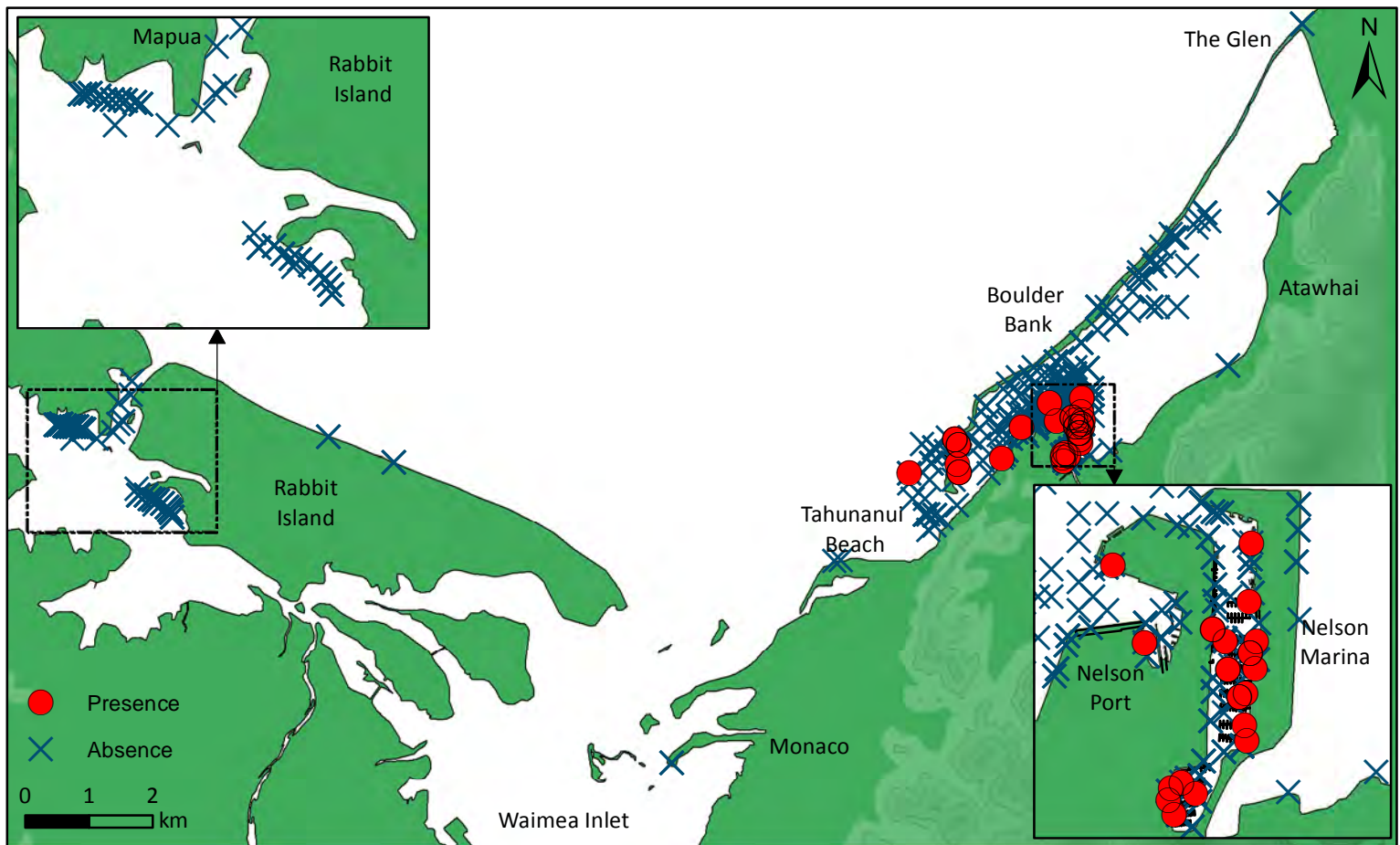
Theora lubrica



Nelson Harbour and Waimea Inlet

Winter 2017

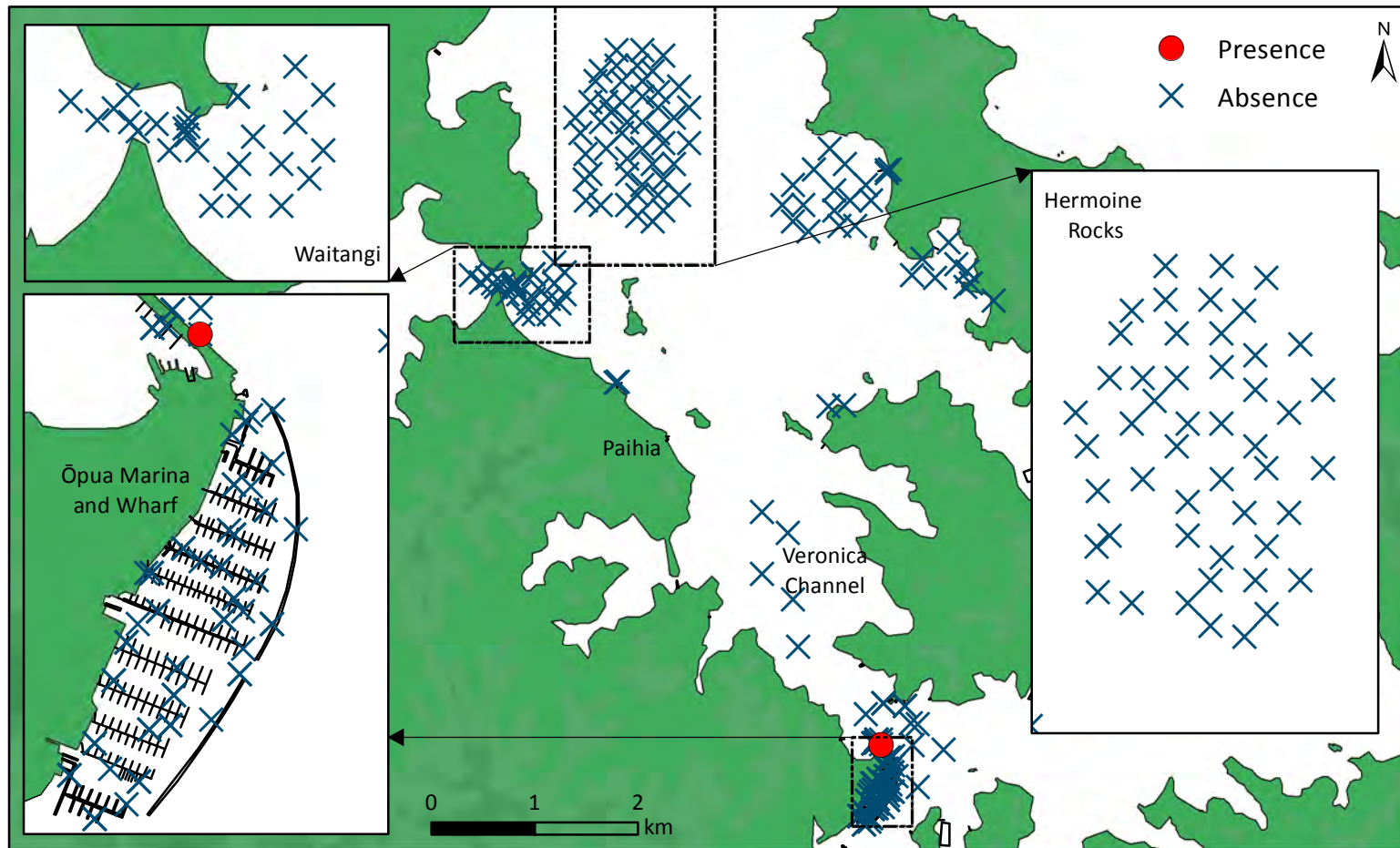
Undaria pinnatifida



Ōpua Marina and Waikare Inlet

Summer 2017-18

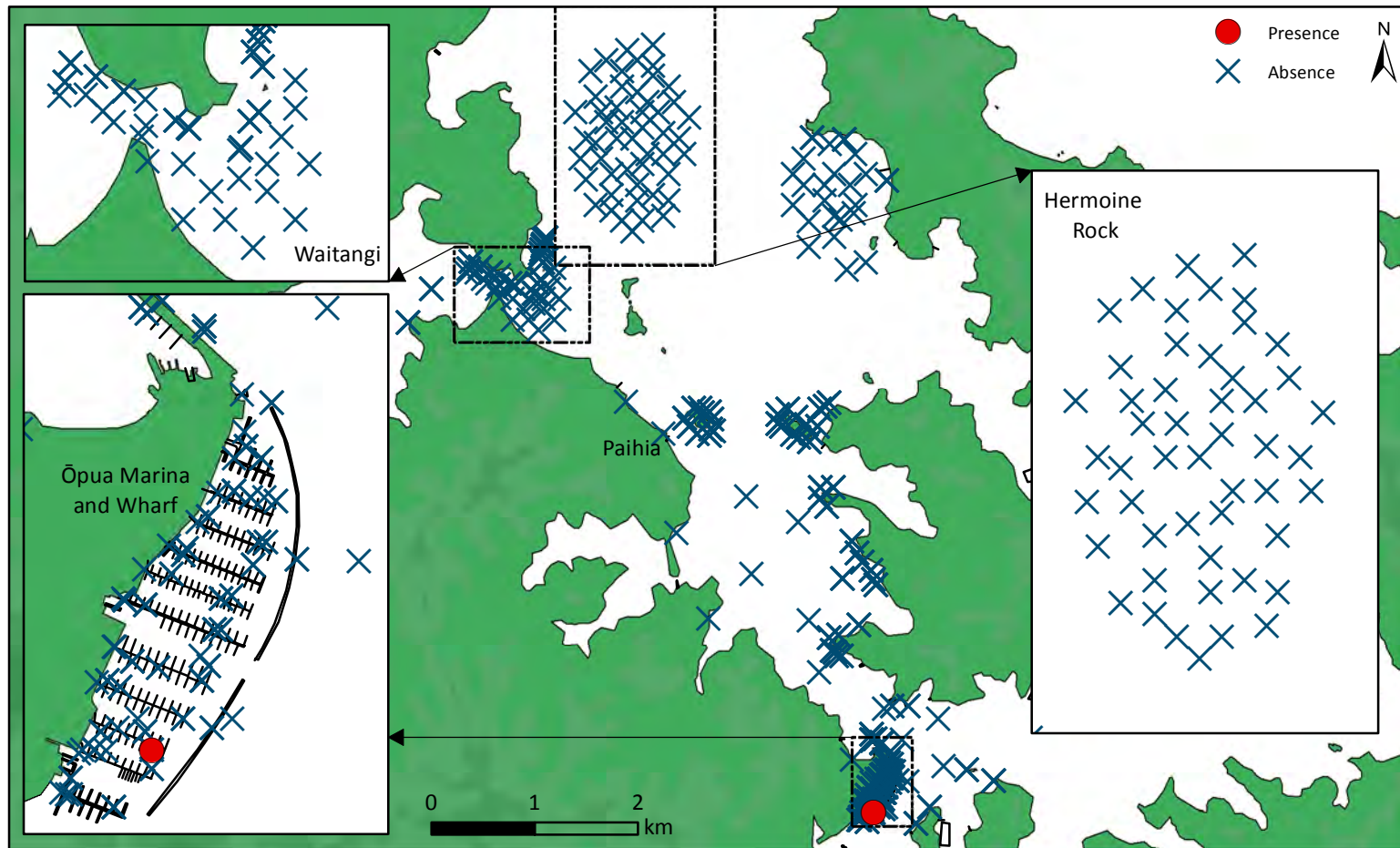
Botrylloides giganteum



Ōpua Marina and Waikare Inlet

Winter 2017

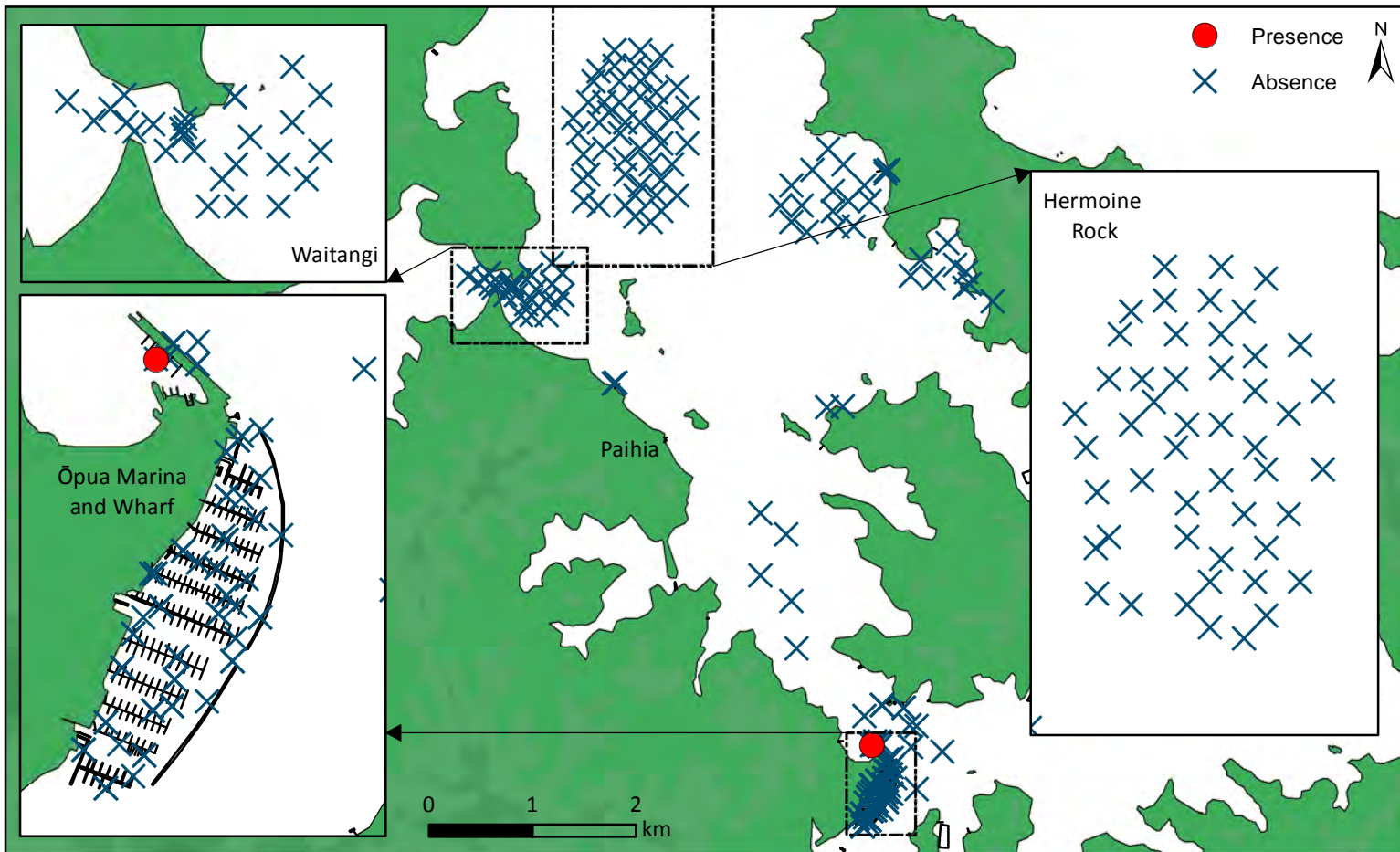
Charybdis (Charybdis) japonica



Ōpua Marina and Waikare Inlet

Summer 2017-18

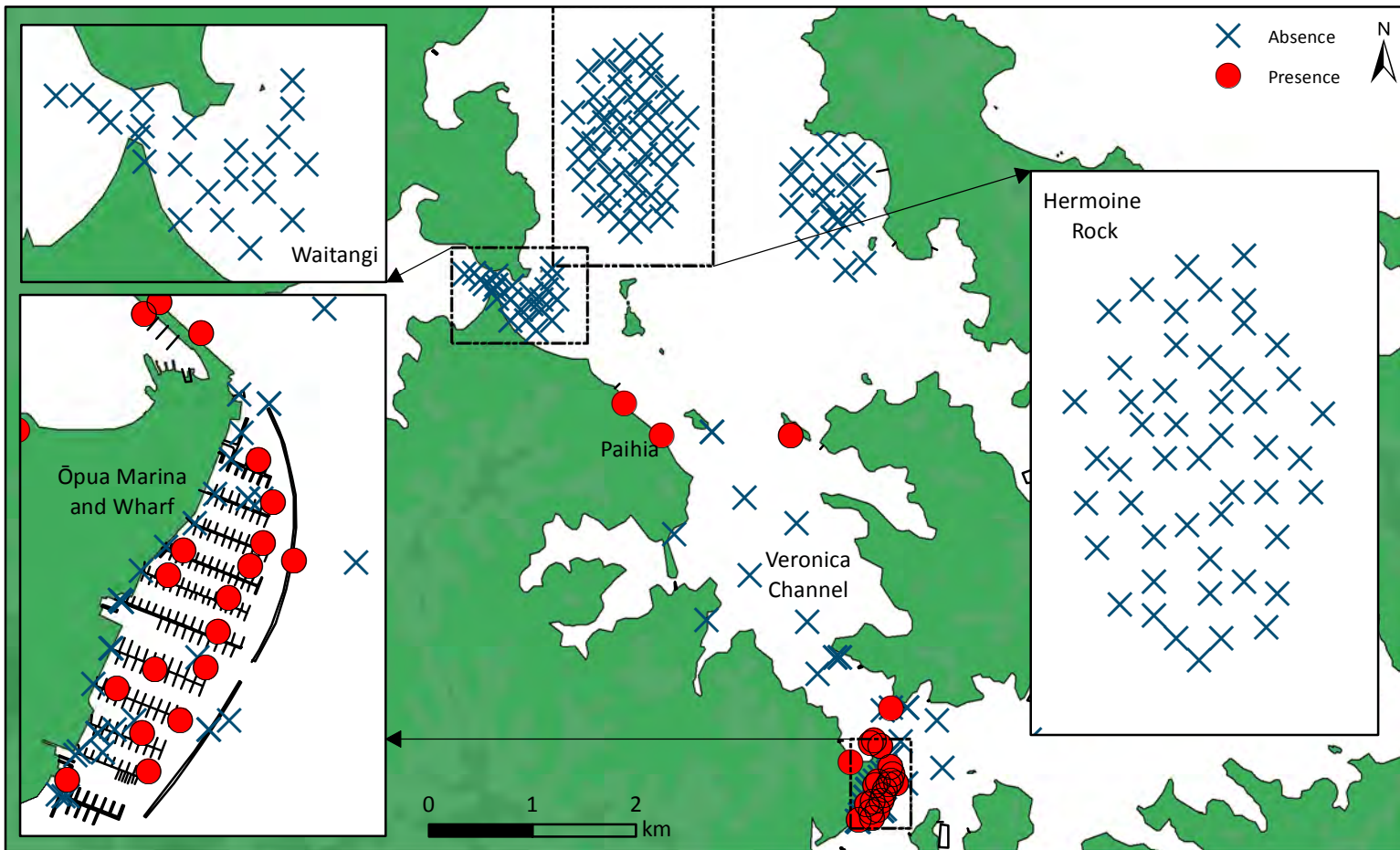
Didemnum vexillum



Ōpua Marina and Waikare Inlet

Winter 2017

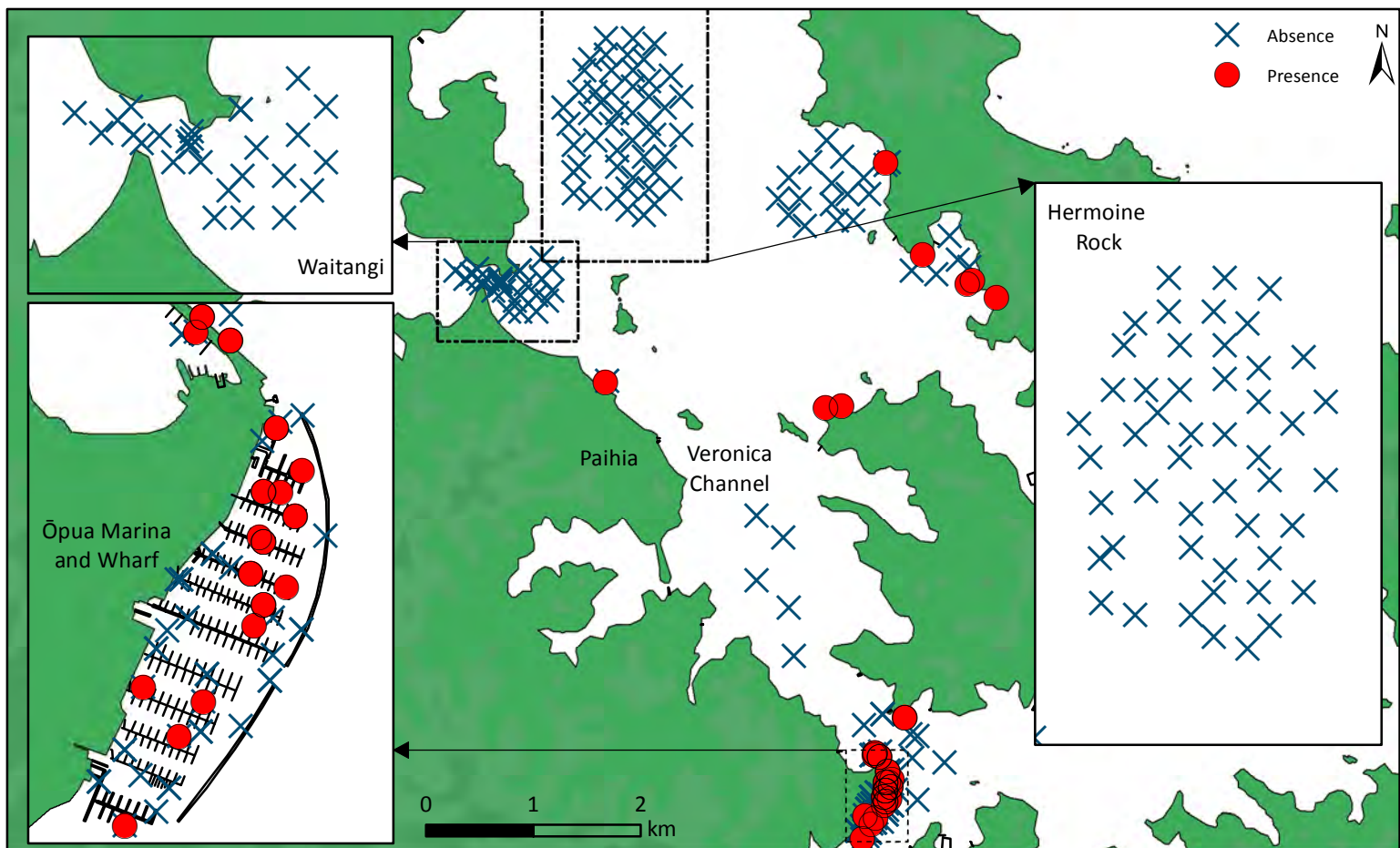
Eudistoma elongatum



Ōpua Marina and Waikare Inlet

Summer 2017-18

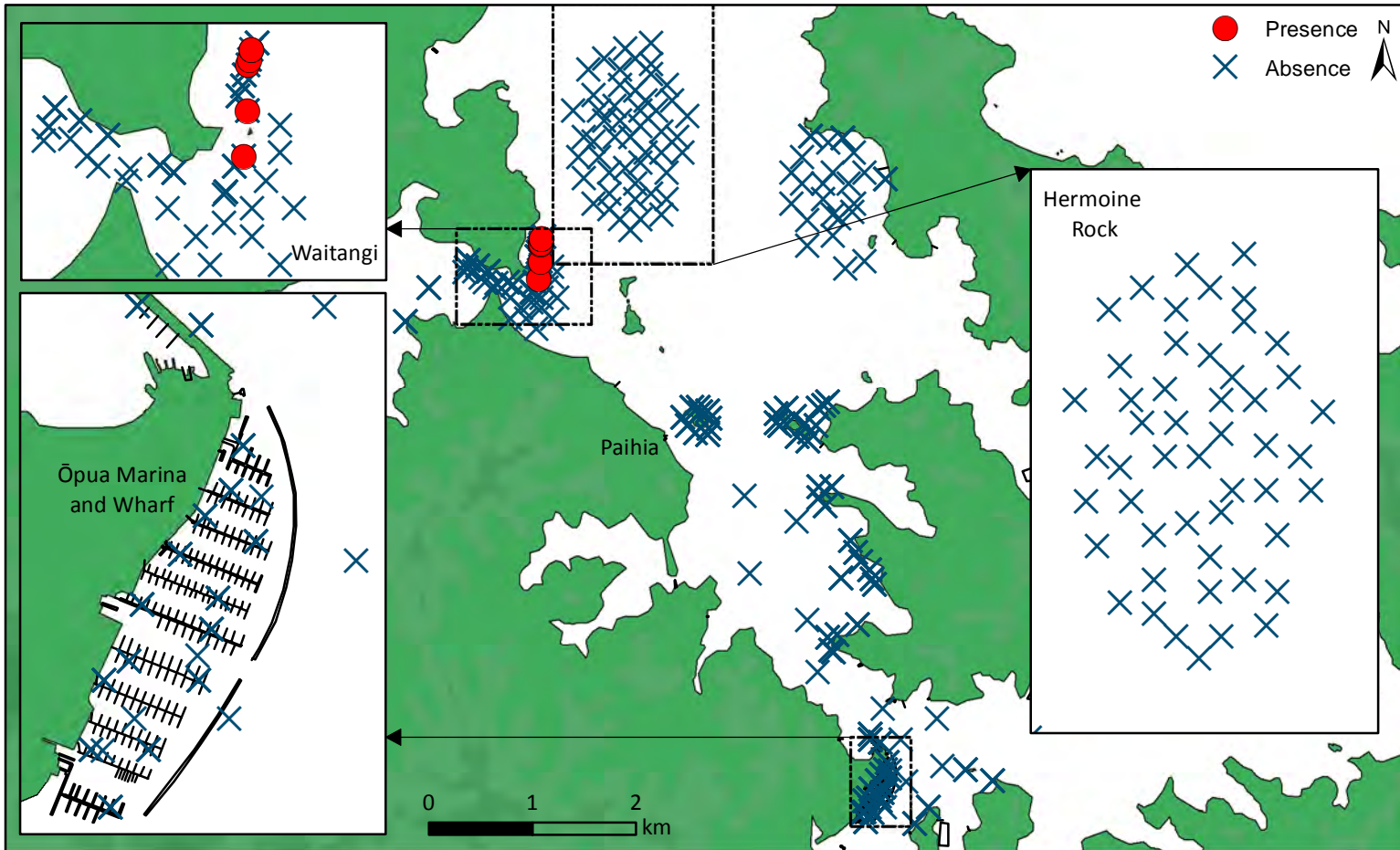
Eudistoma elongatum



Ōpua Marina and Waikare Inlet

Winter 2017

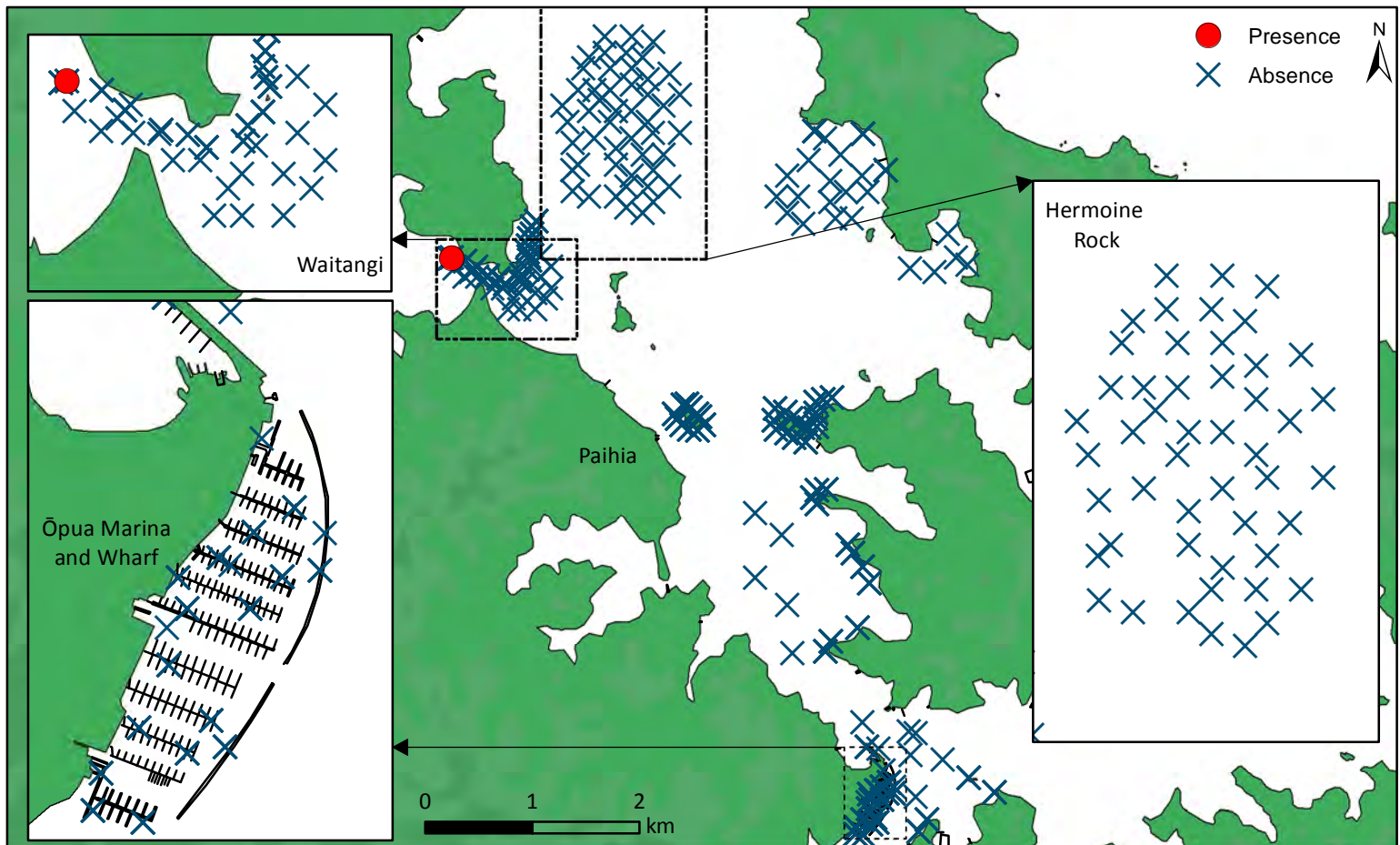
Metapenaeus bennettiae



Ōpua Marina and Waikare Inlet

Summer 2017-18

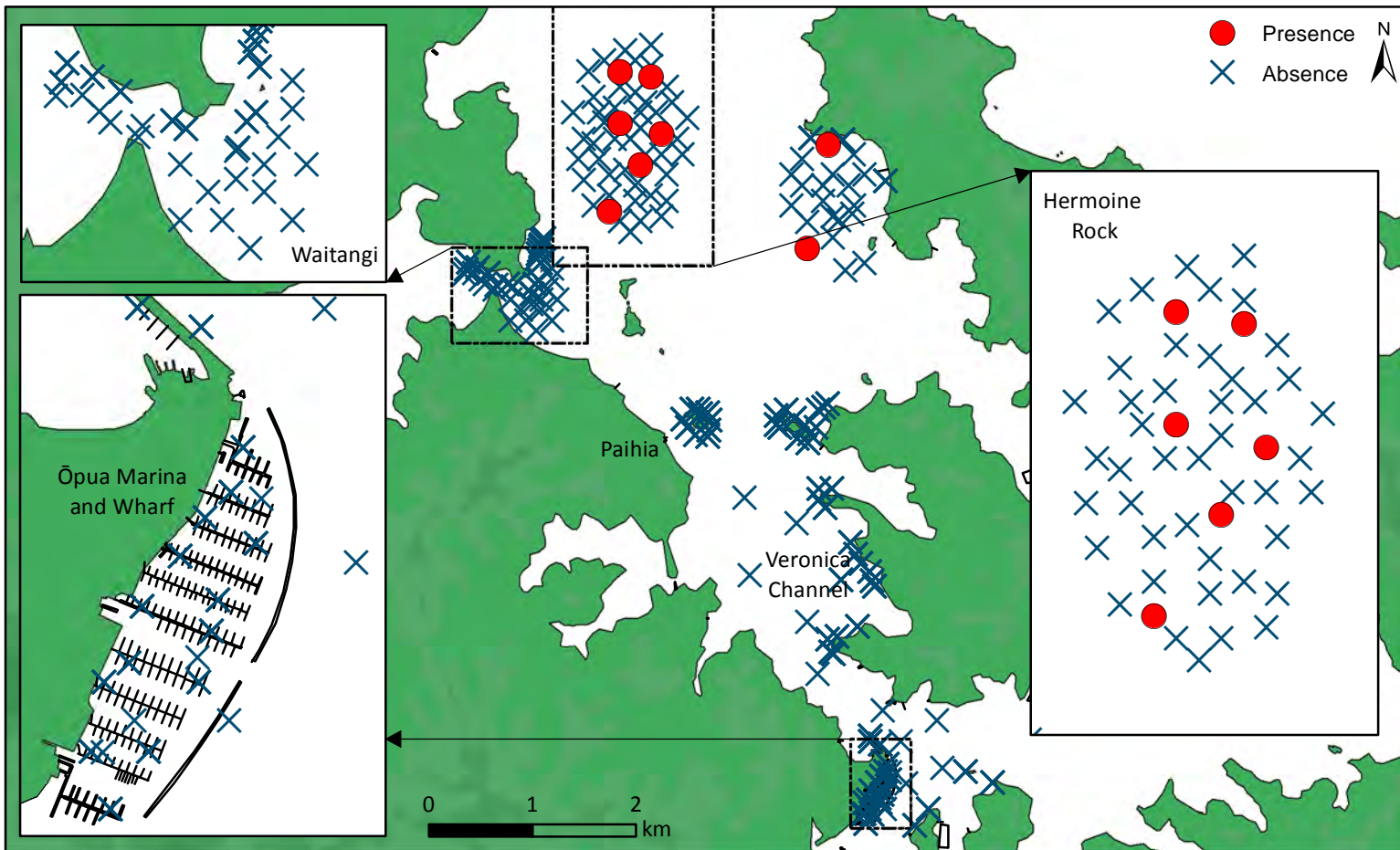
Metapenaeus bennettiae



Ōpua Marina and Waikare Inlet

Winter 2017

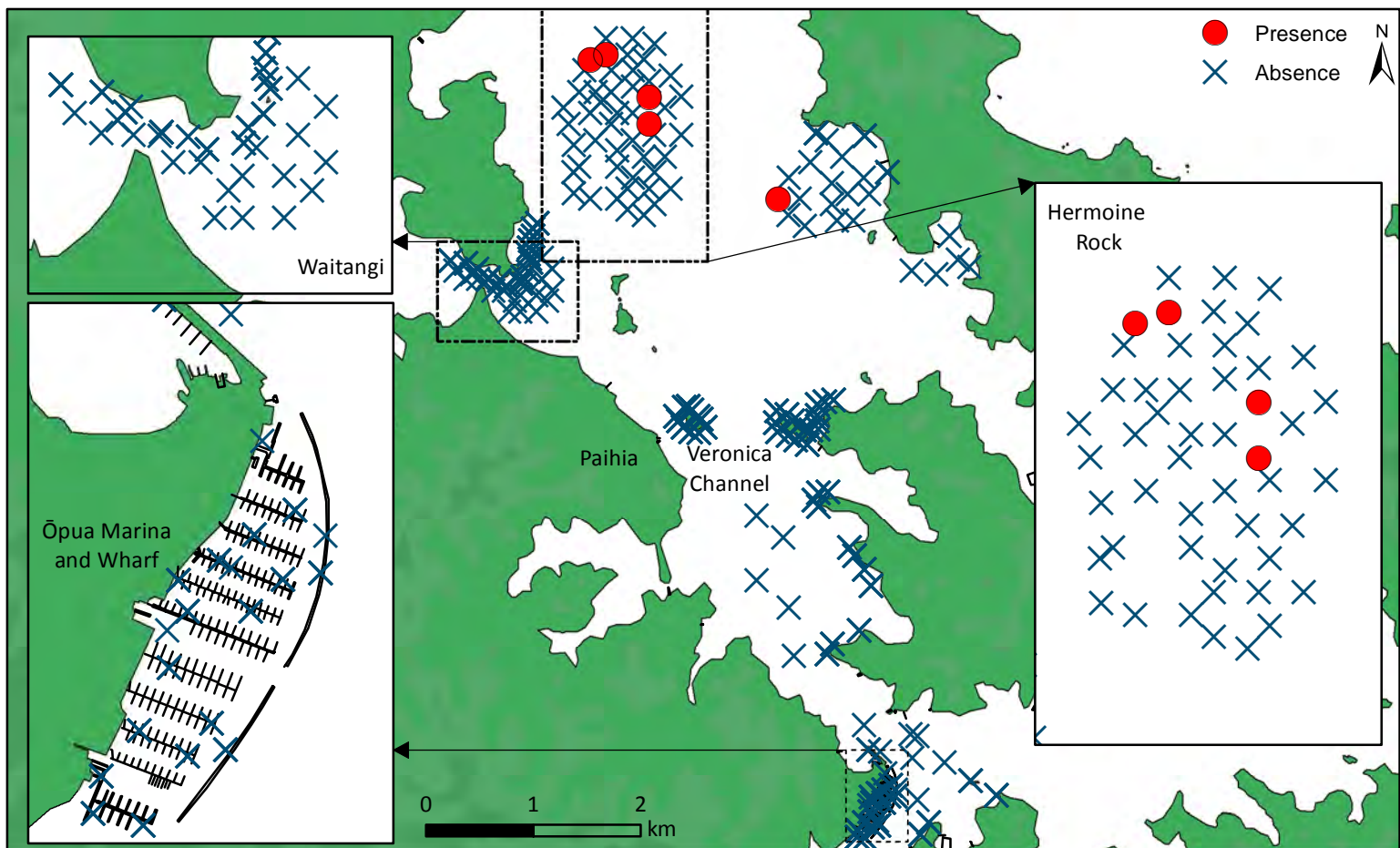
Pyromaia tuberculata



Ōpua Marina and Waikare Inlet

Summer 2017-18

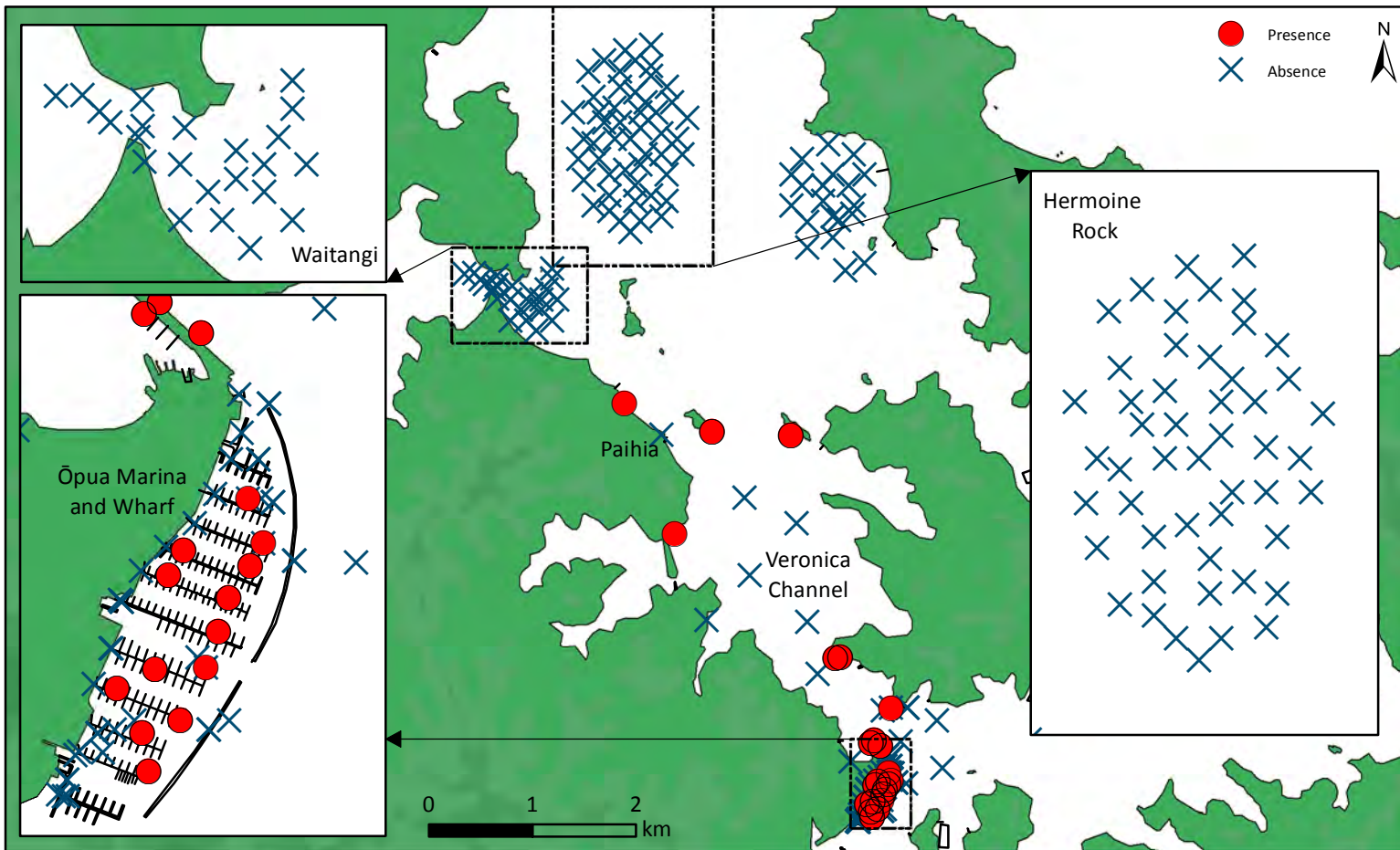
Pyromaia tuberculata



Ōpua Marina and Waikare Inlet

Winter 2017

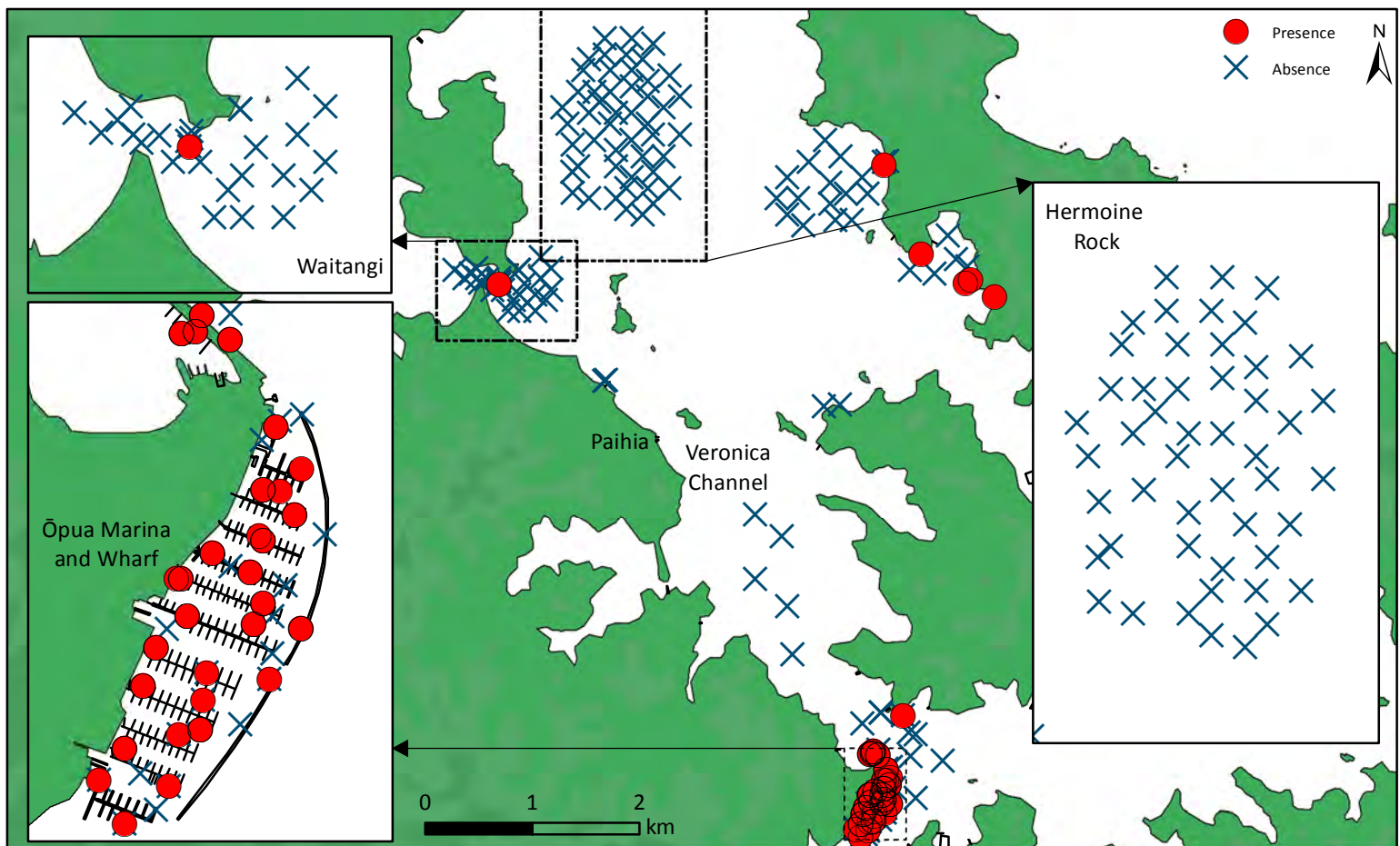
Styela clava



Ōpua Marina and Waikare Inlet

Summer 2017-18

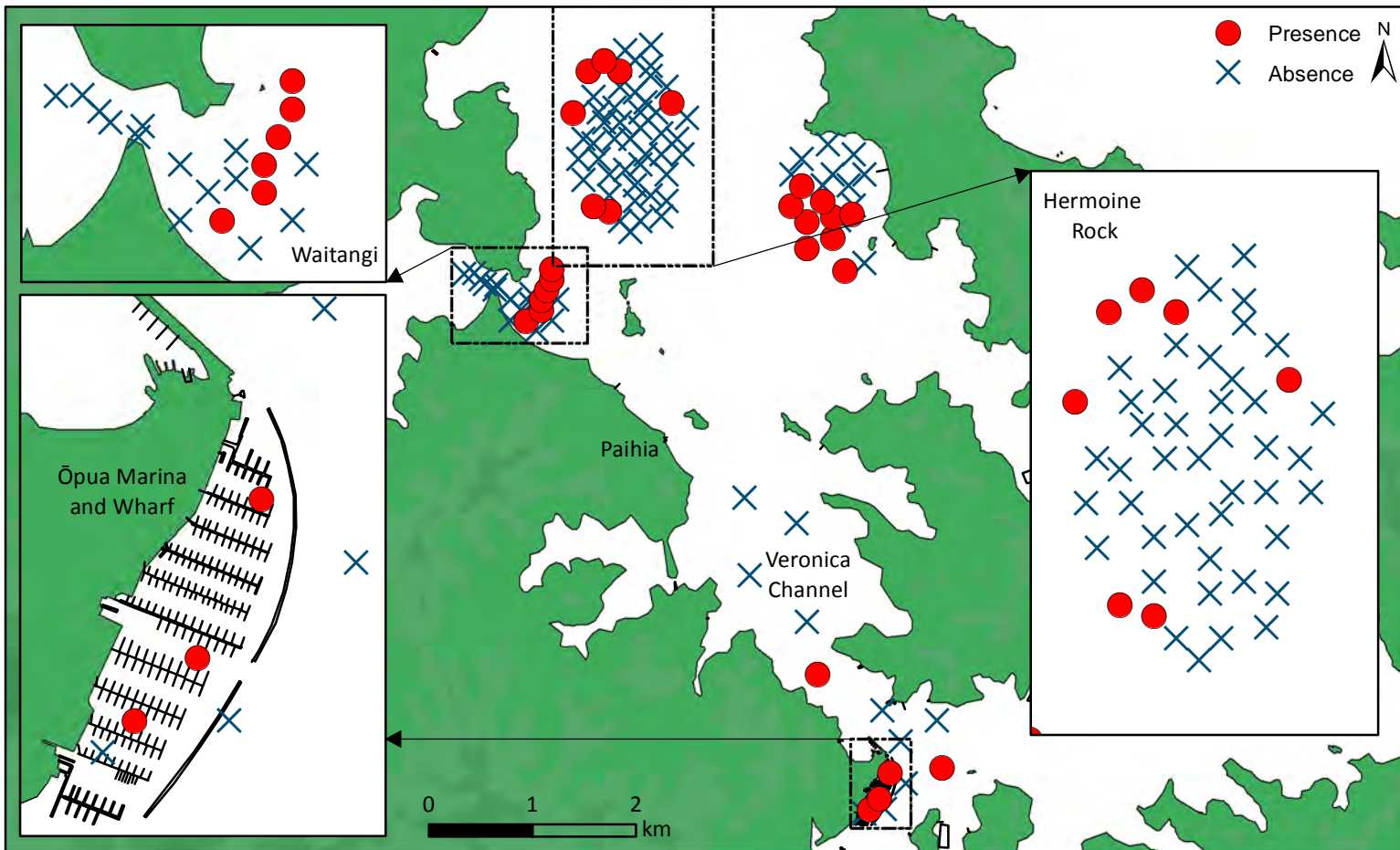
Styela clava



Ōpua Marina and Waikare Inlet

Winter 2017

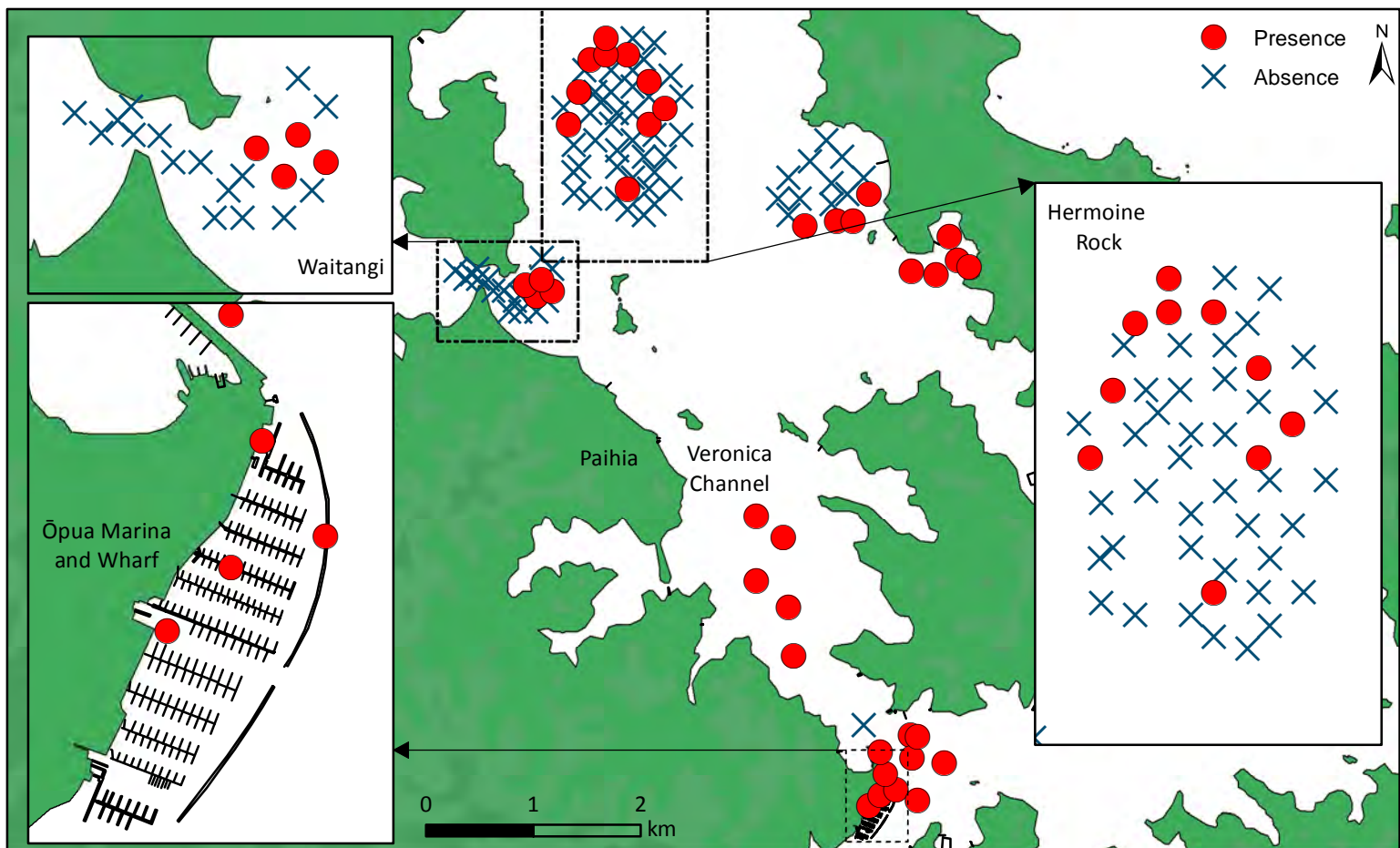
Theora lubrica



Ōpua Marina and Waikare Inlet

Summer 2017-18

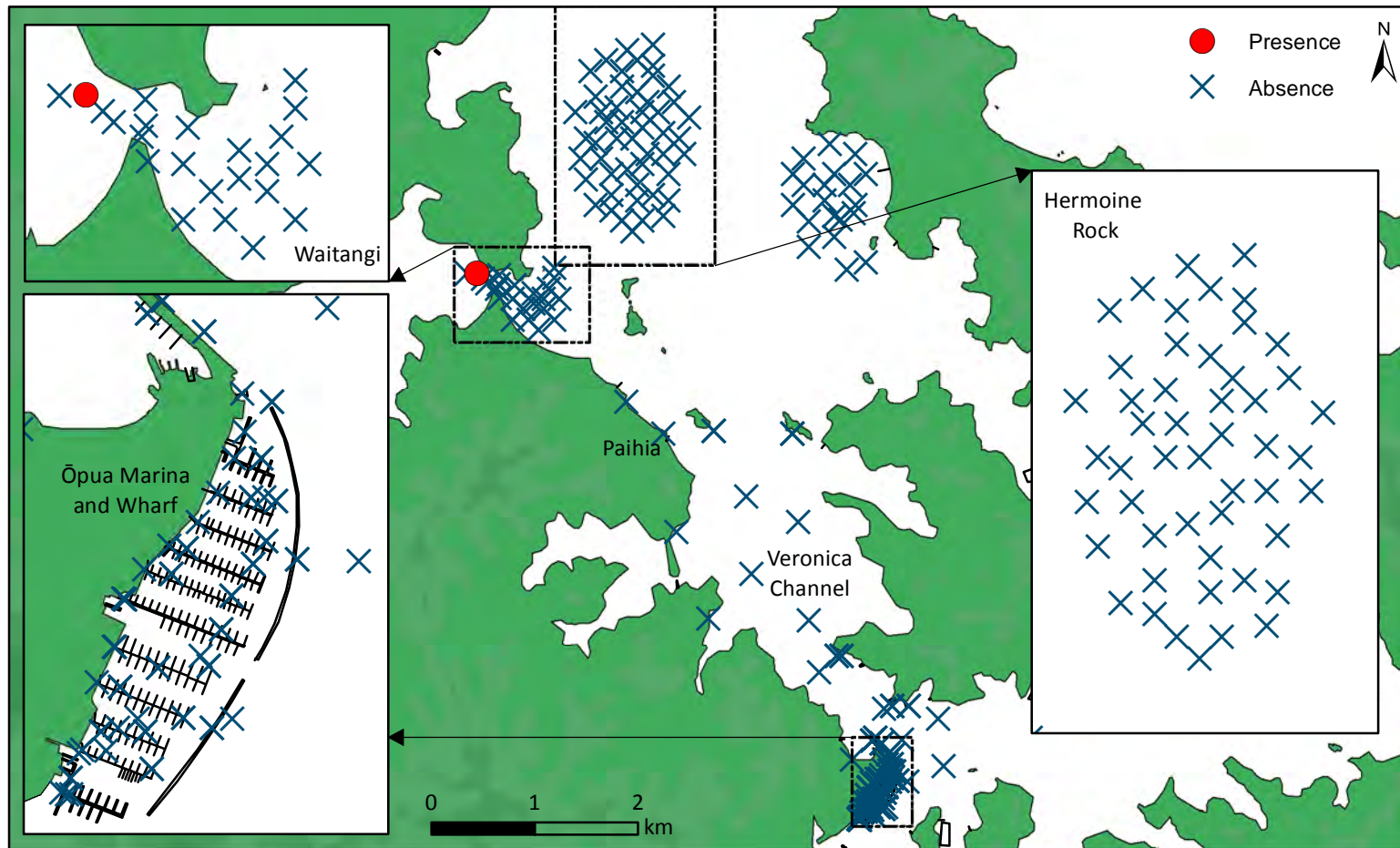
Theora lubrica



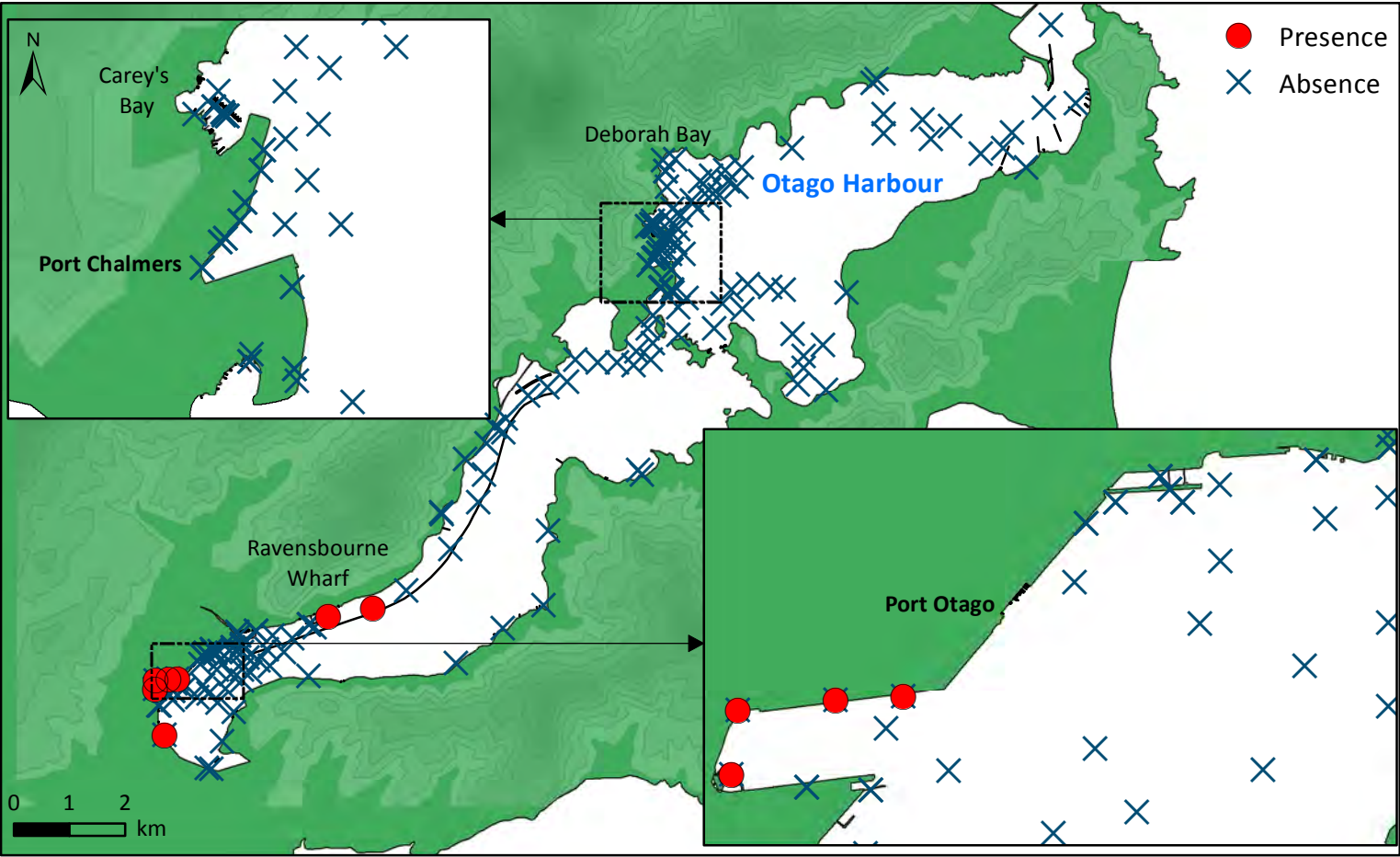
Ōpua Marina and Waikare Inlet

Winter 2017

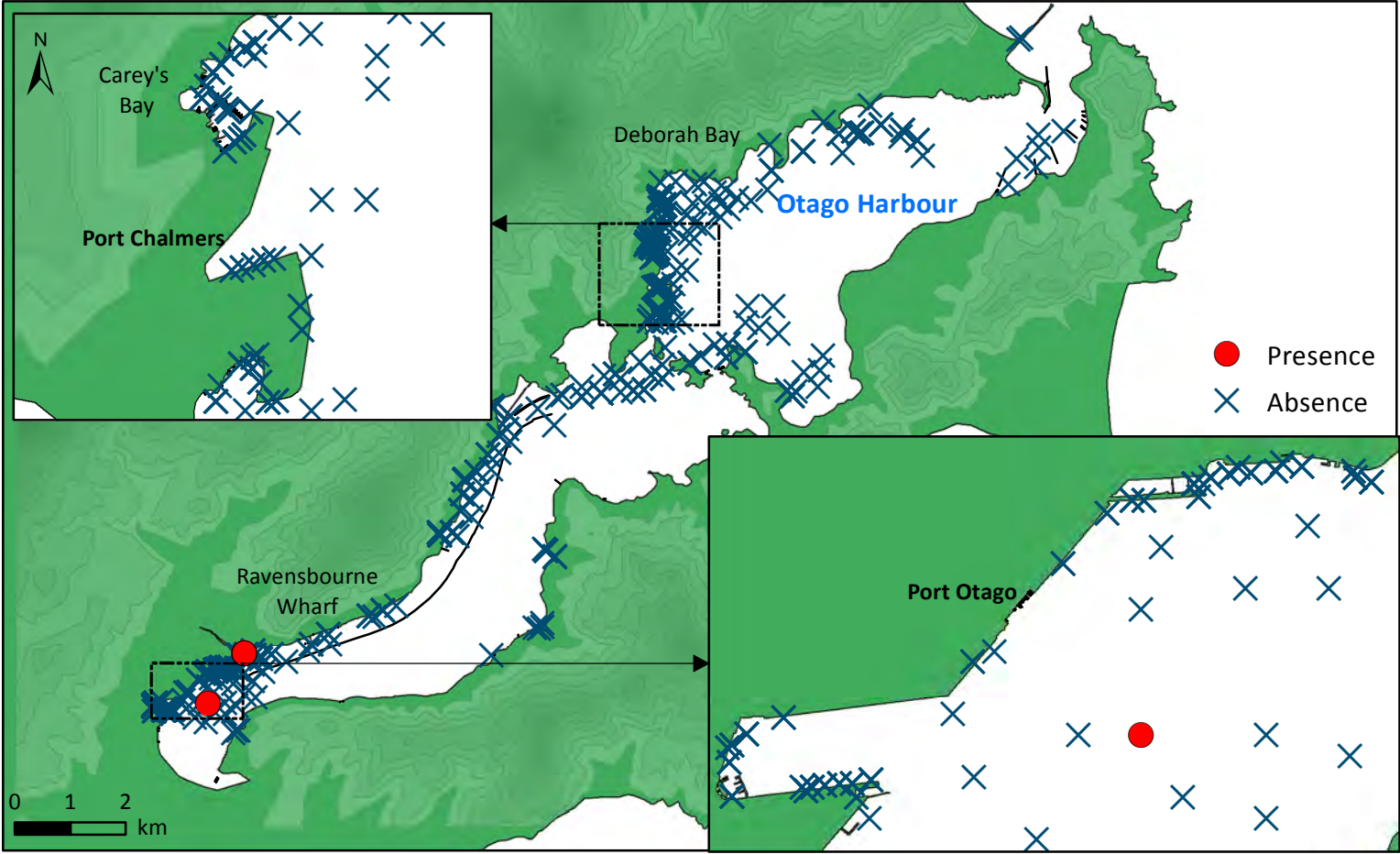
Tritia burchardi



Otago Harbour
Winter 2017
Ascidella aspersa



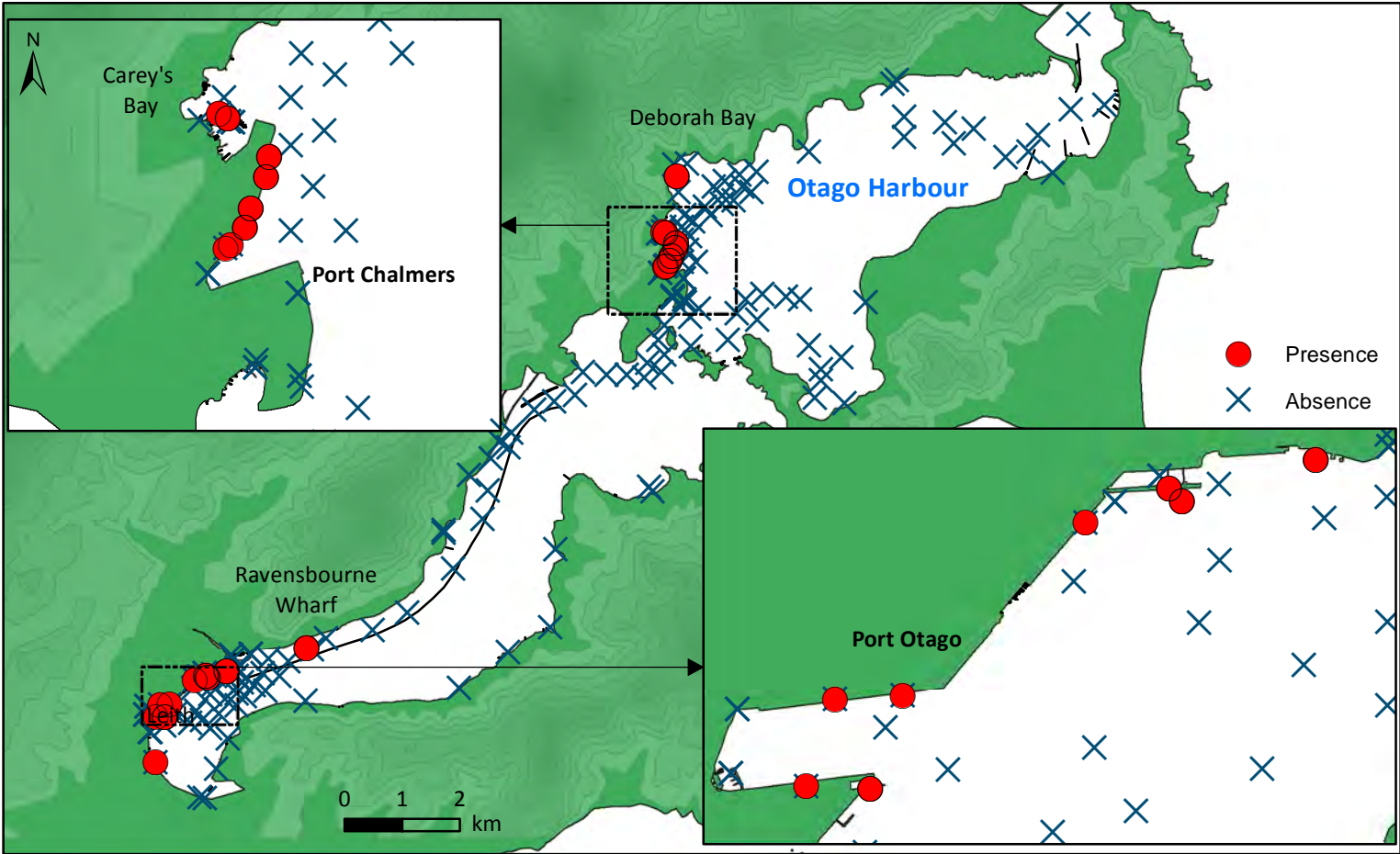
Otago Harbour
Summer 2017-18
Ciona spp.



Otago Harbour

Winter 2017

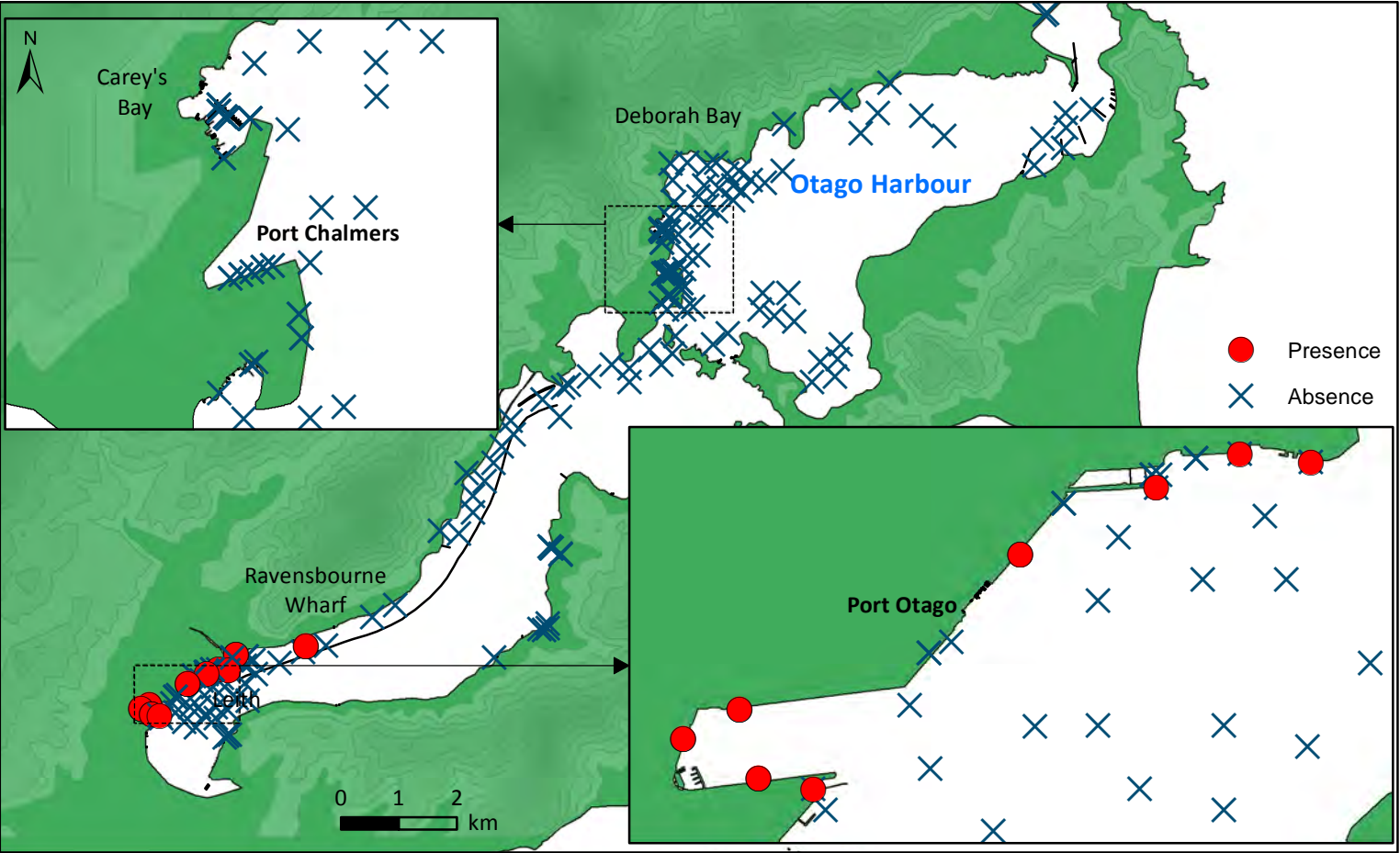
Didemnum vexillum



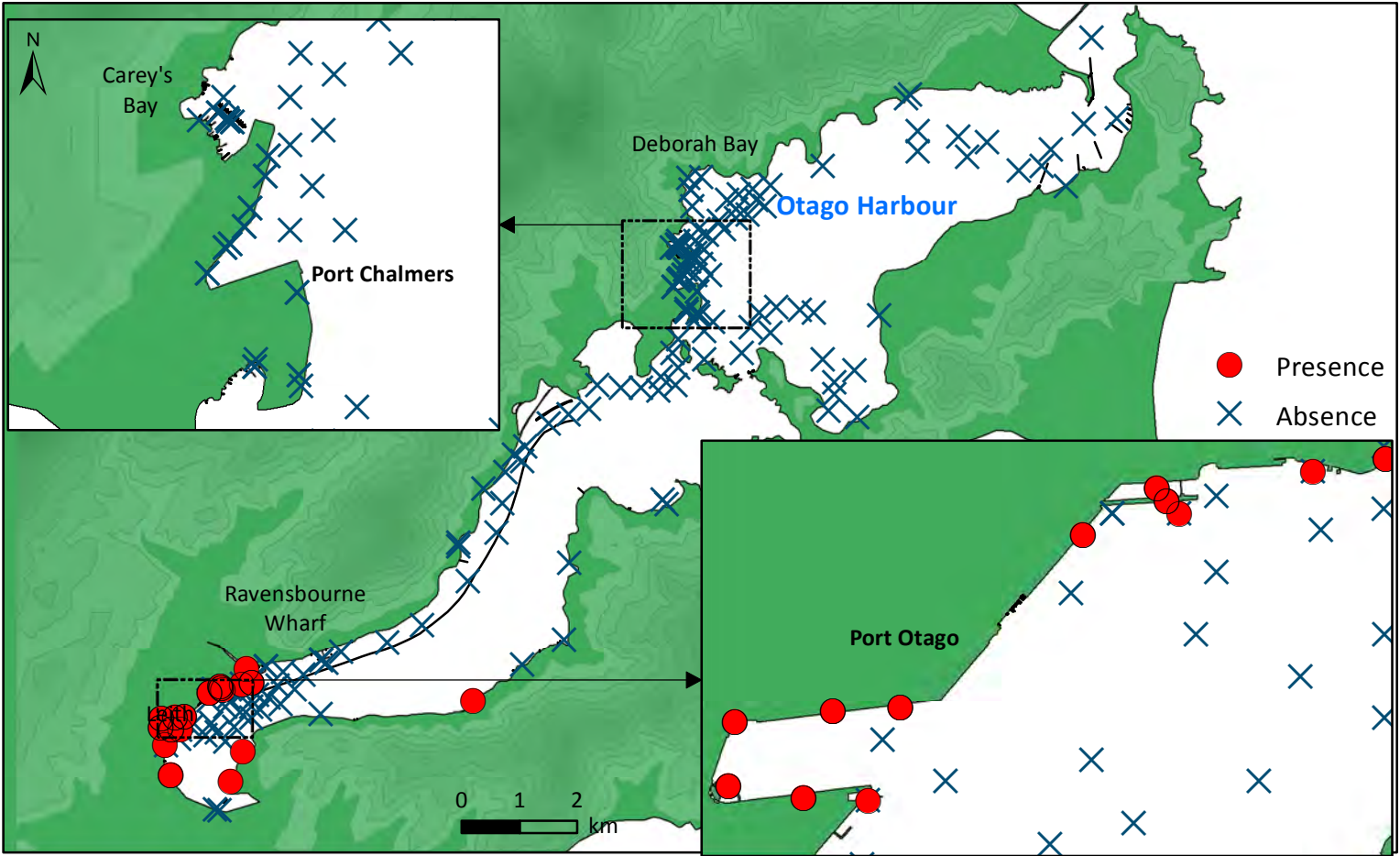
Otago Harbour

Summer 2017-18

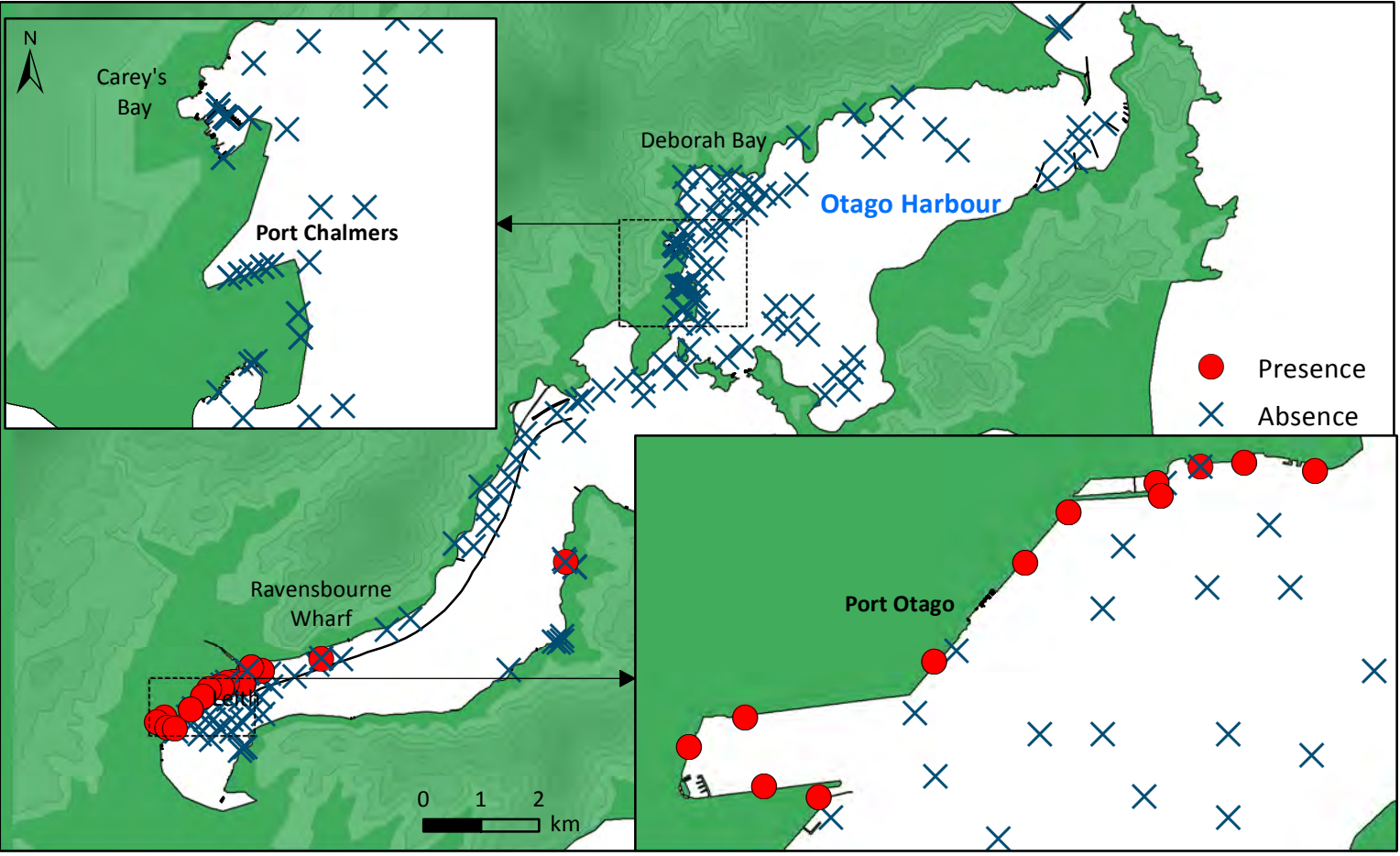
Didemnum vexillum



Otago Harbour
Winter 2017
Styela clava



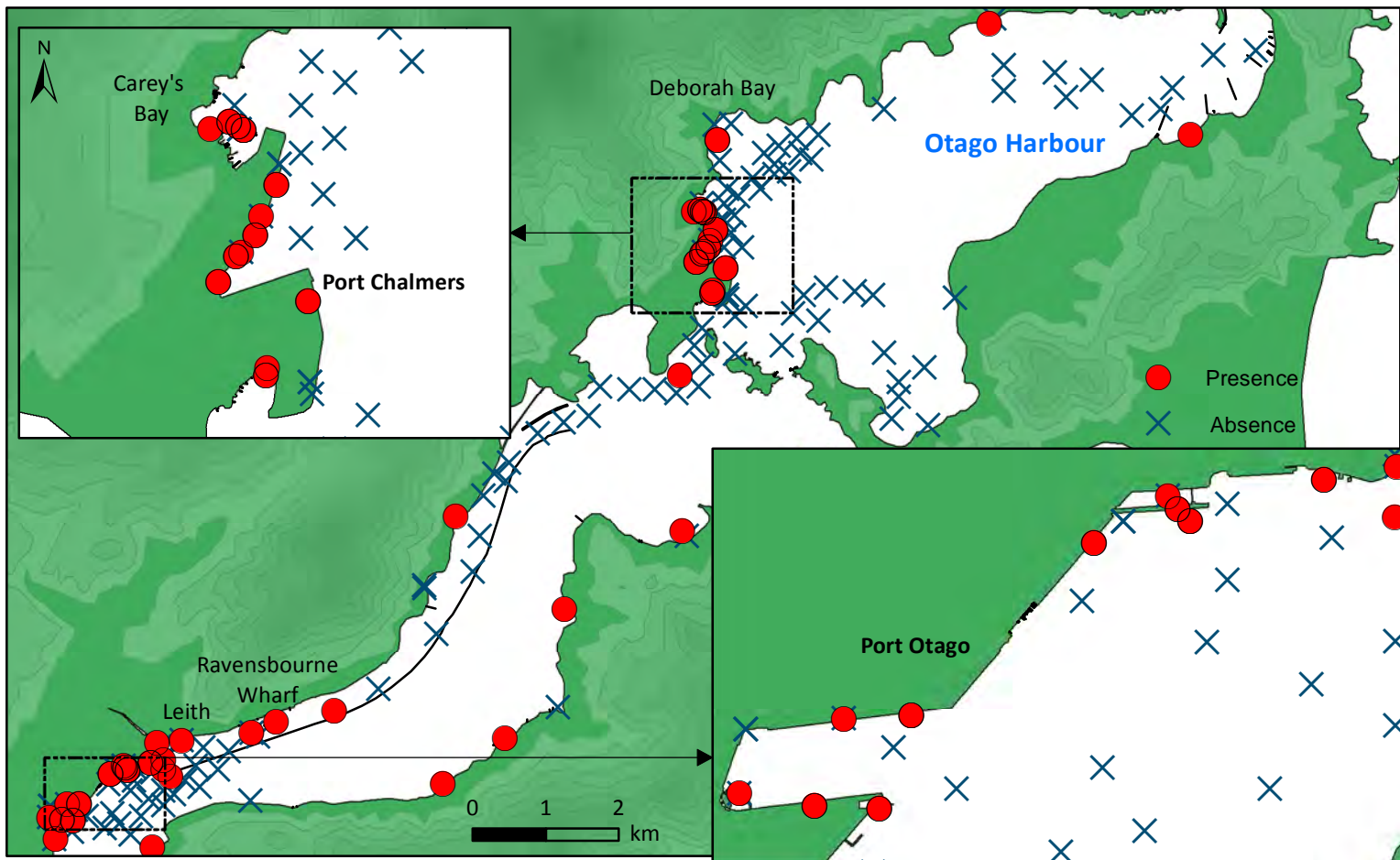
Otago Harbour
Summer 2017-18
Styela clava



Otago Harbour

Winter 2017

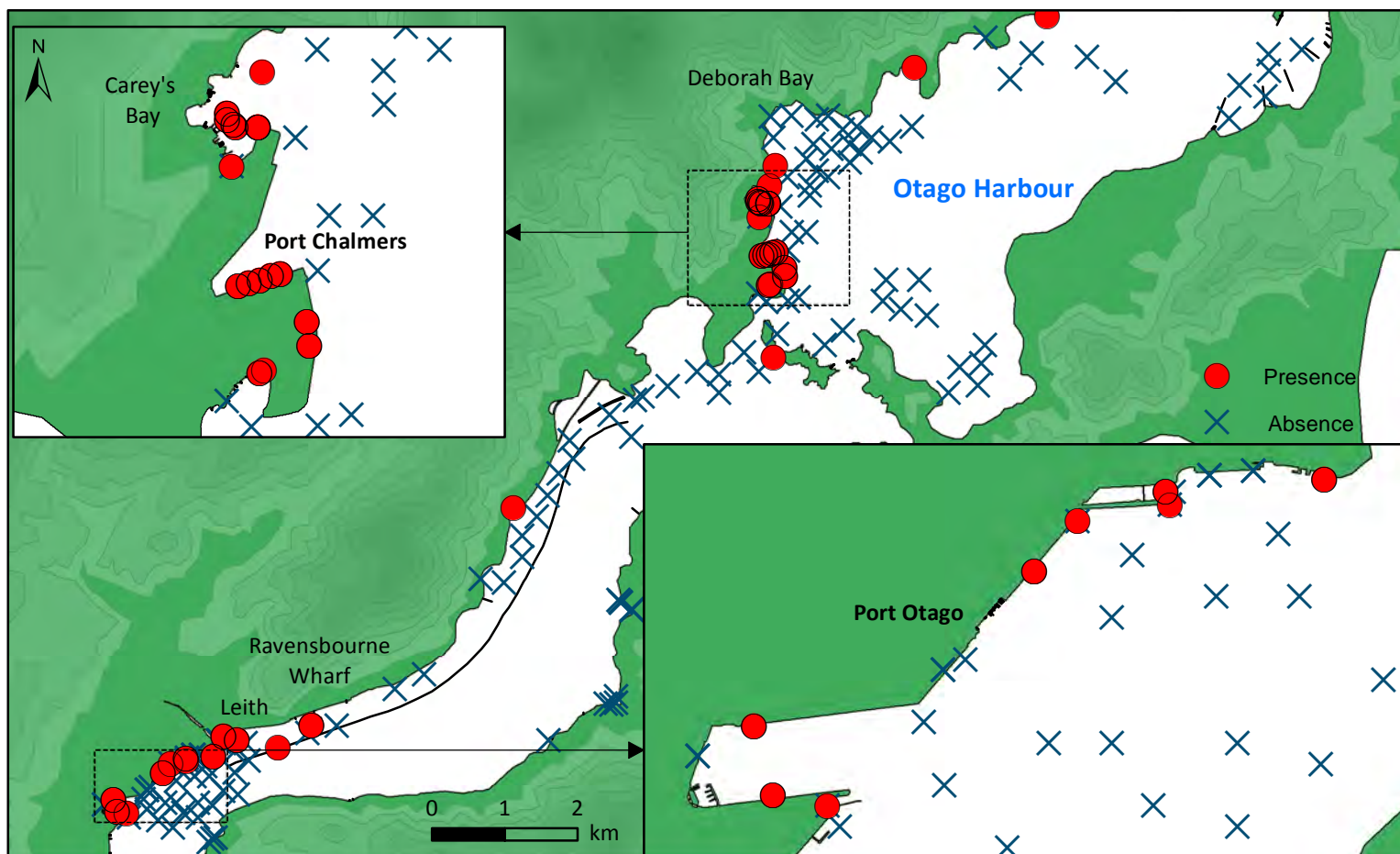
Undaria pinnatifida



Otago Harbour

Summer 2017-18

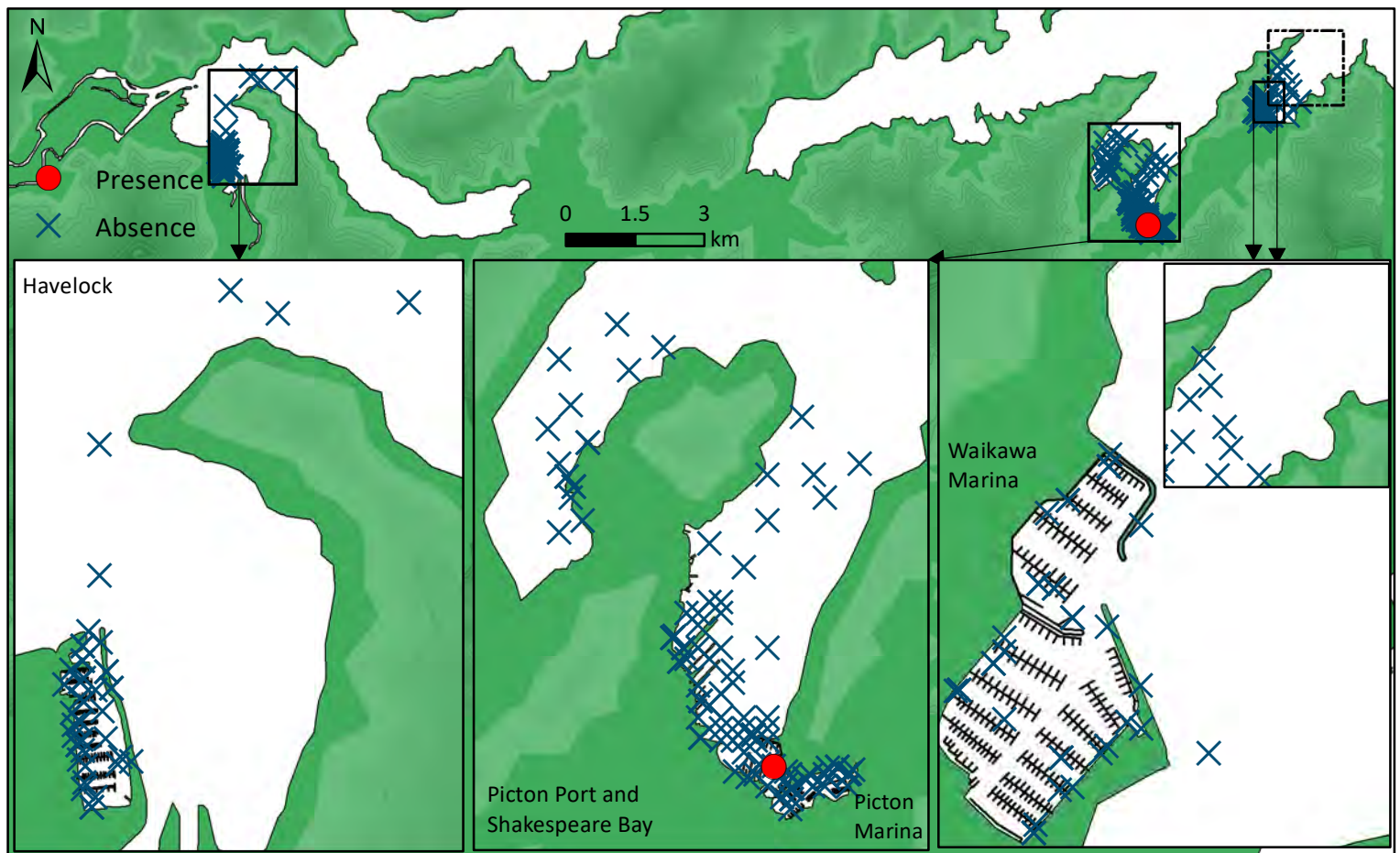
Undaria pinnatifida



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

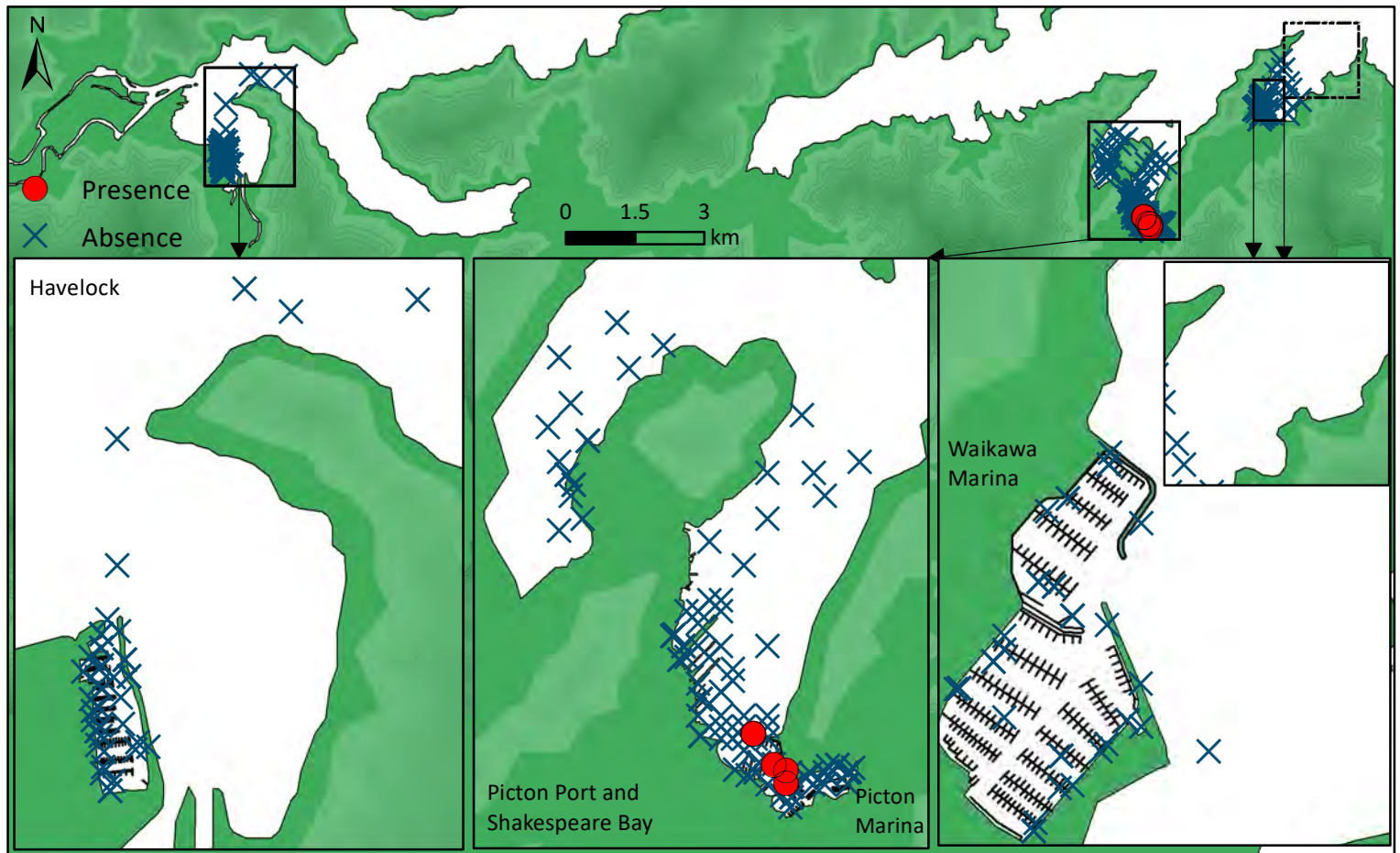
Ciona spp.



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

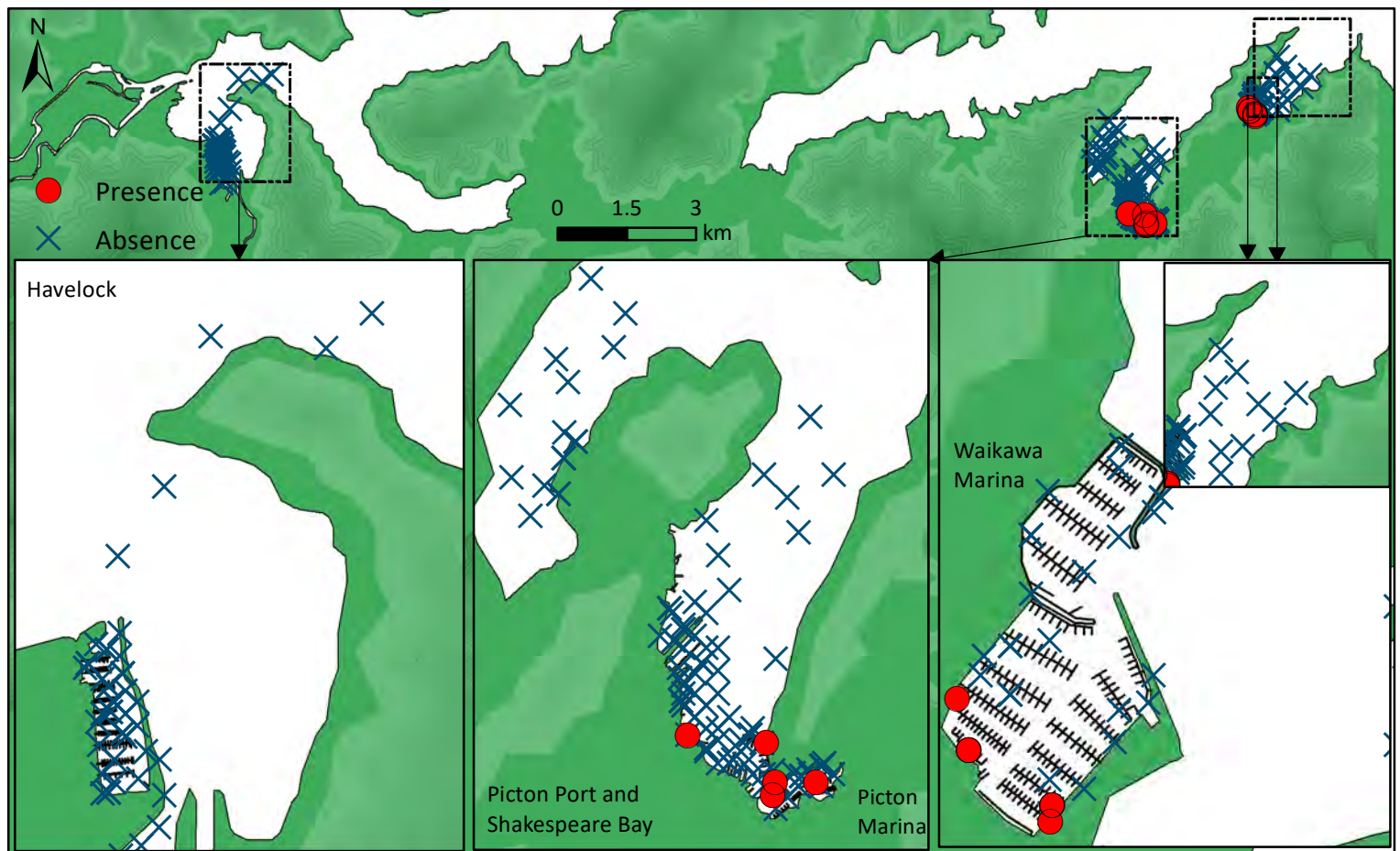
Clavelina lepadiformis



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

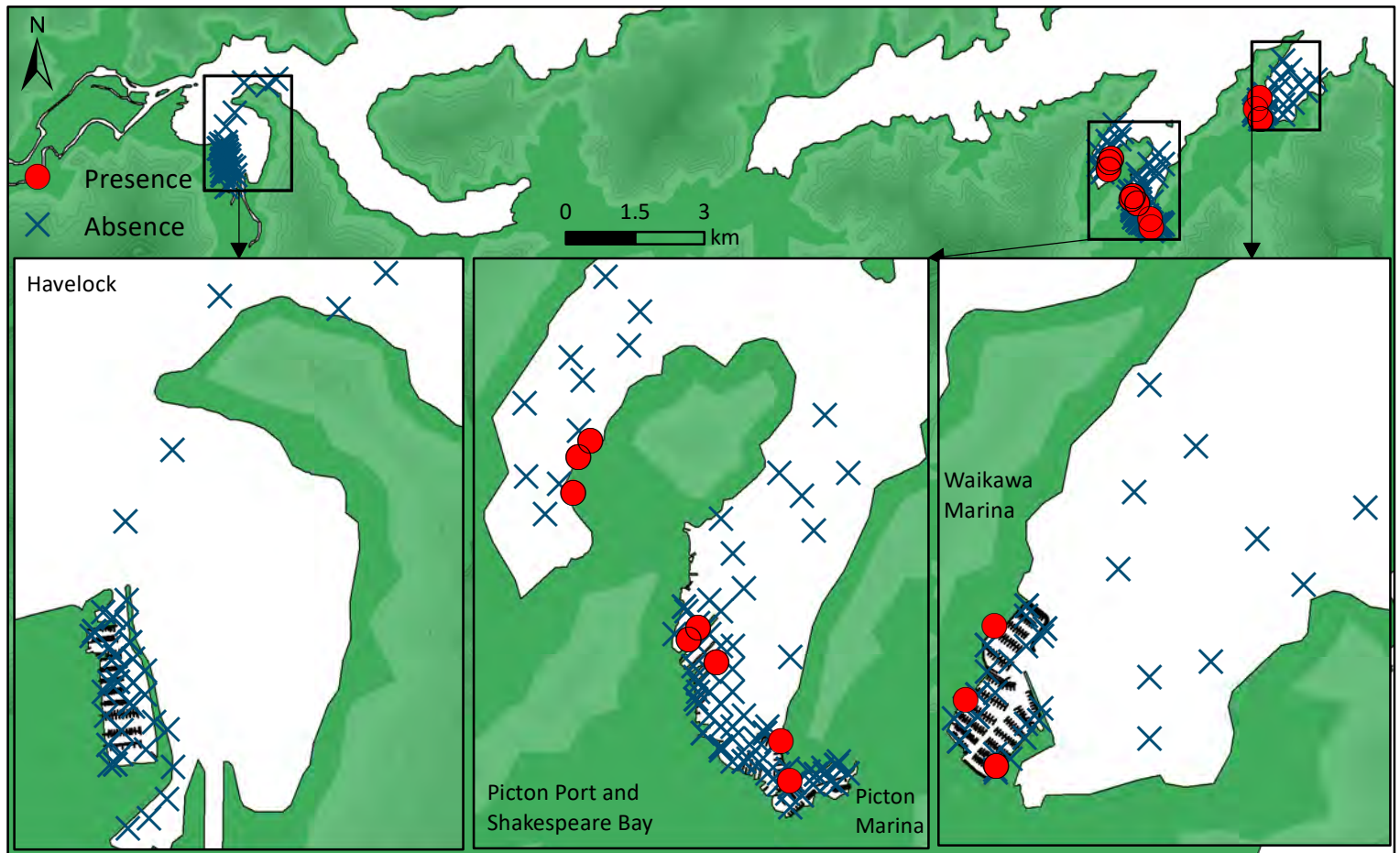
Clavelina lepadiformis



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

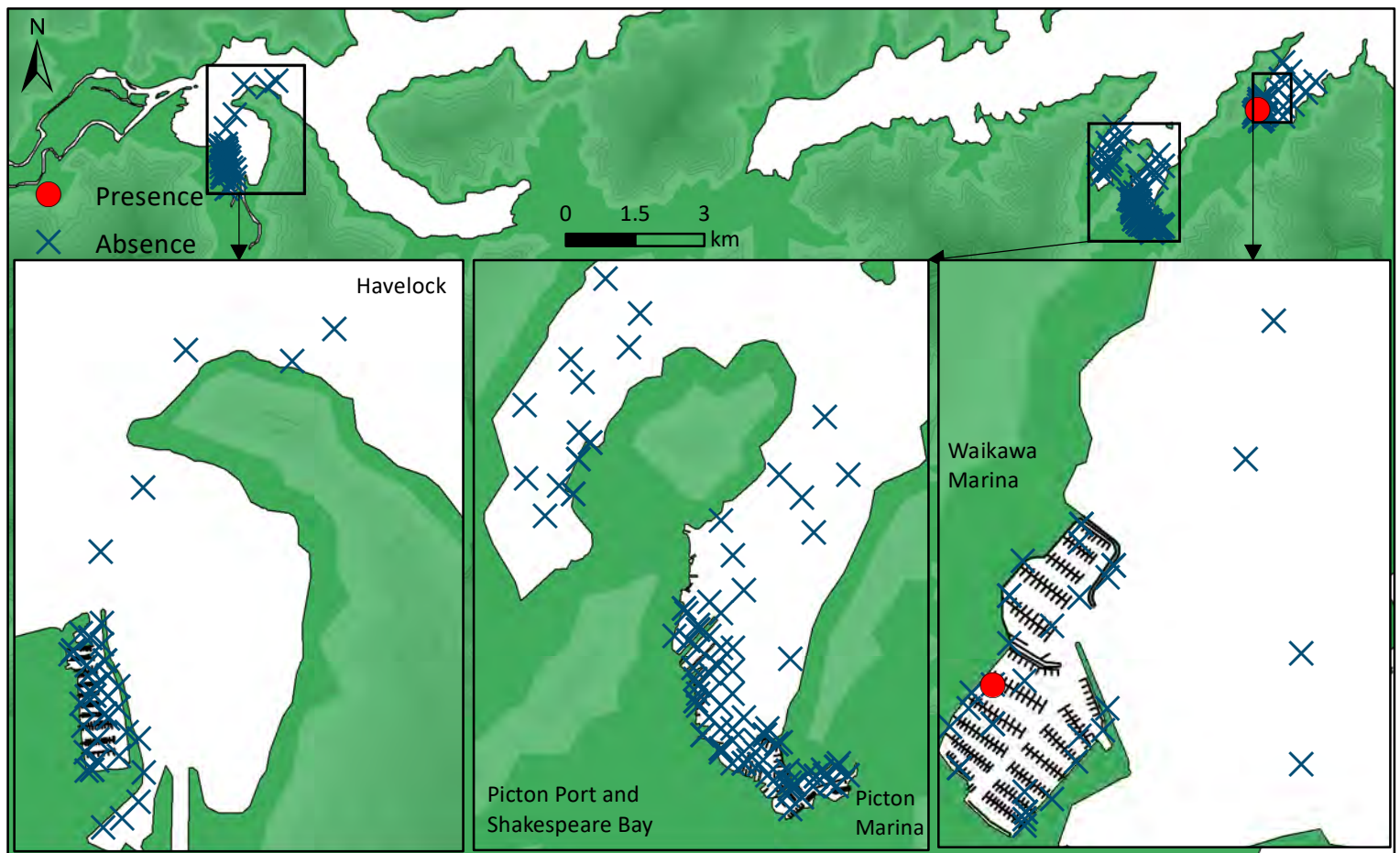
Didemnum vexillum



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

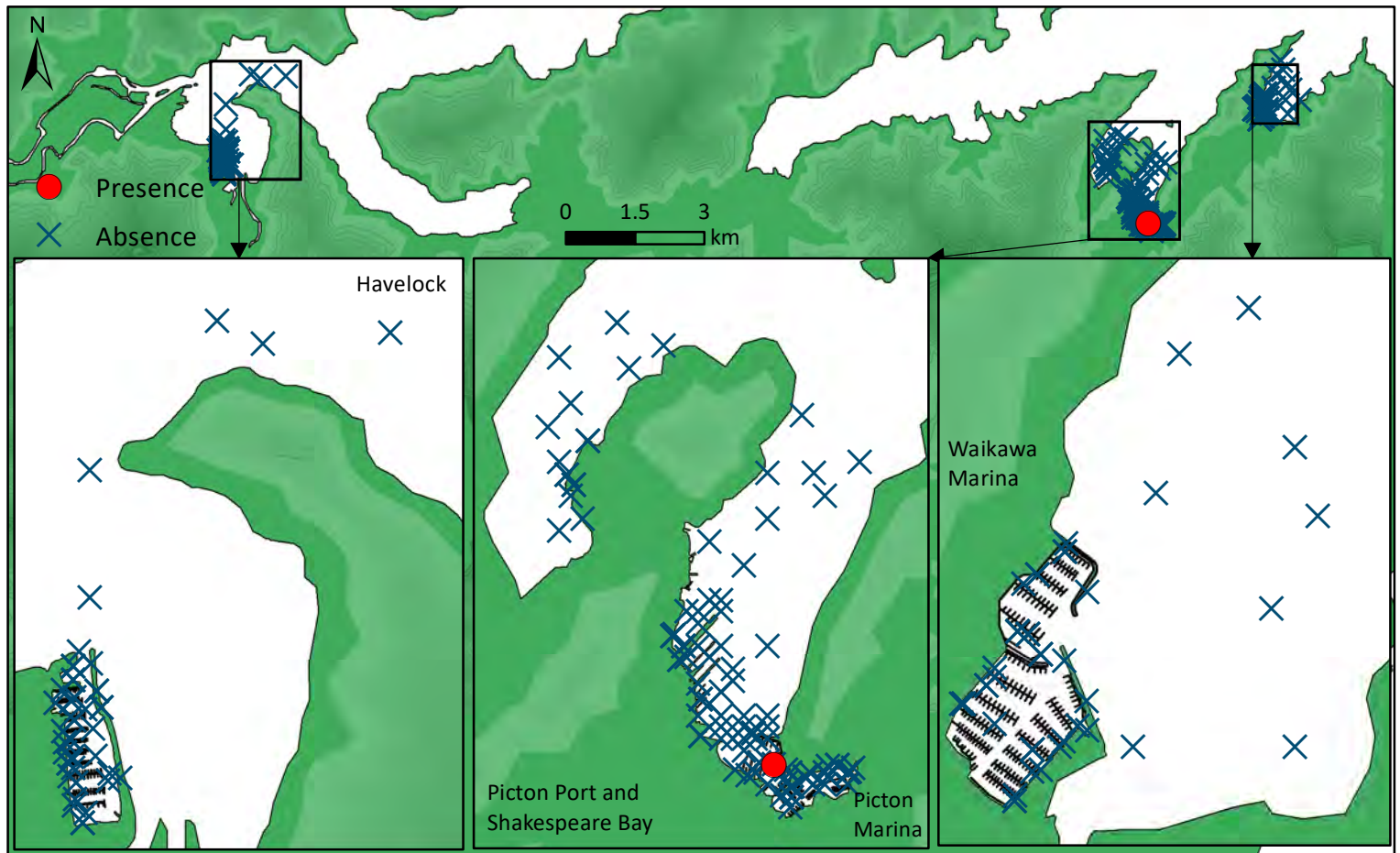
Ectopleura spp.



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

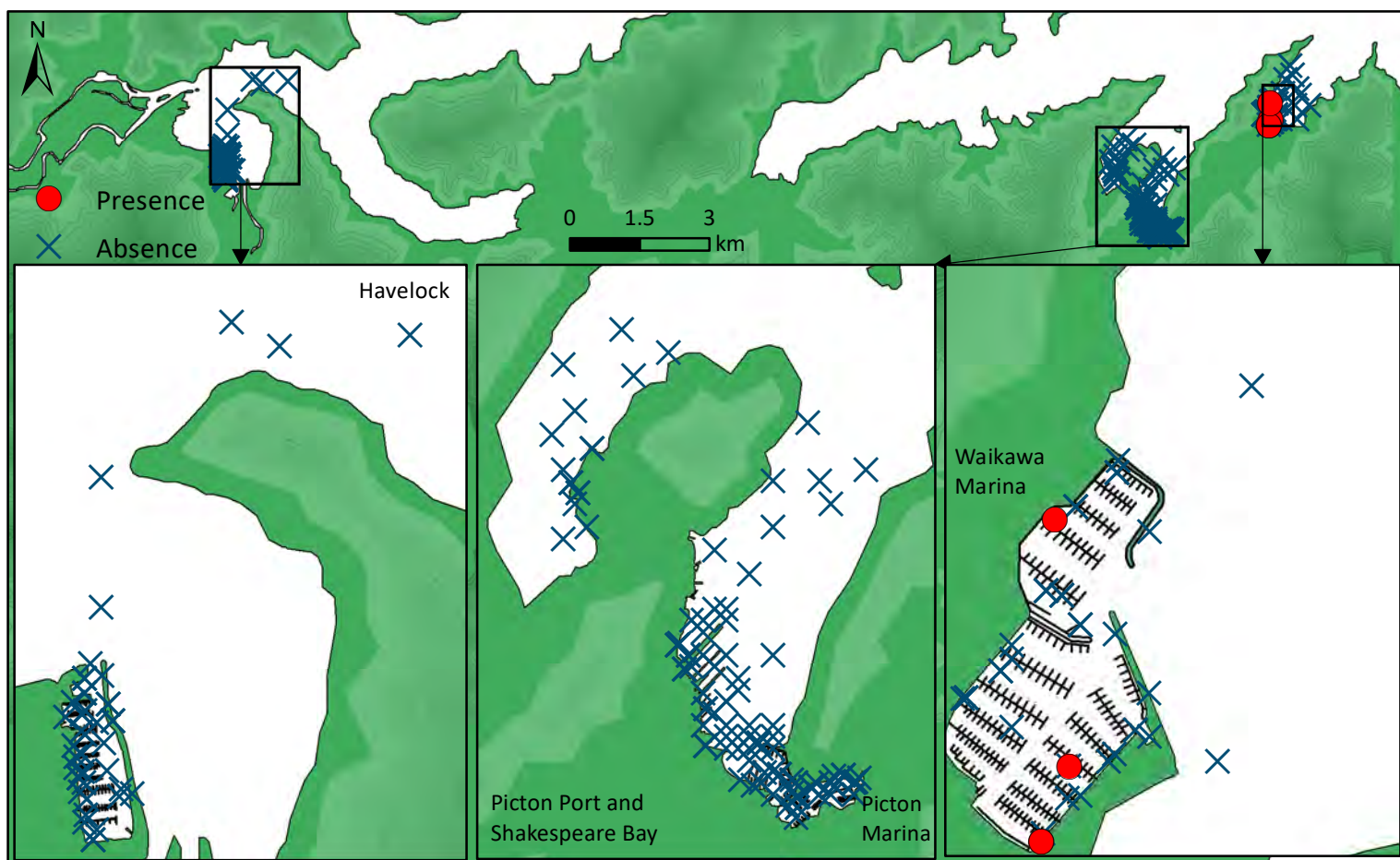
Sabella spallanzanii



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

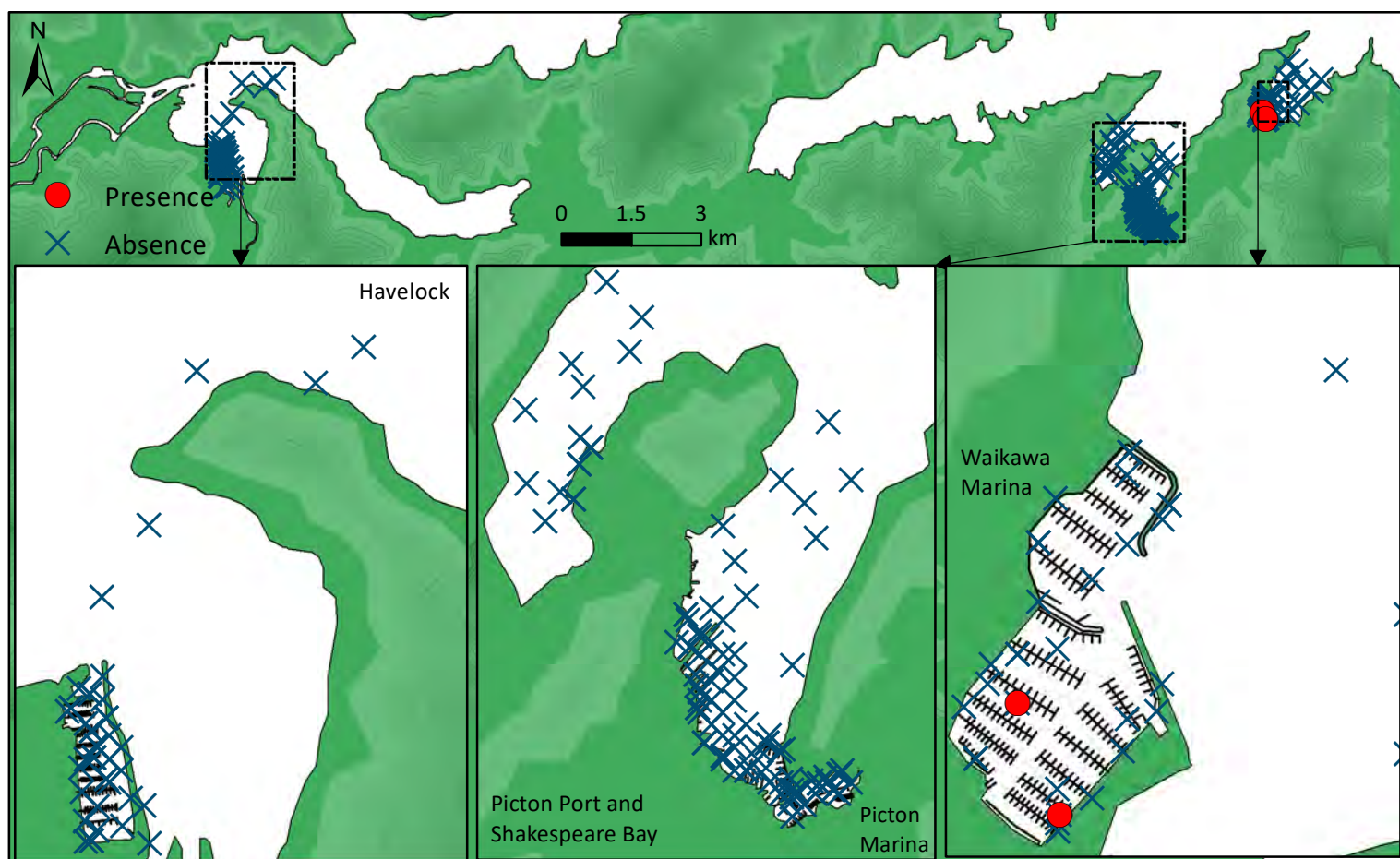
Styela clava



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

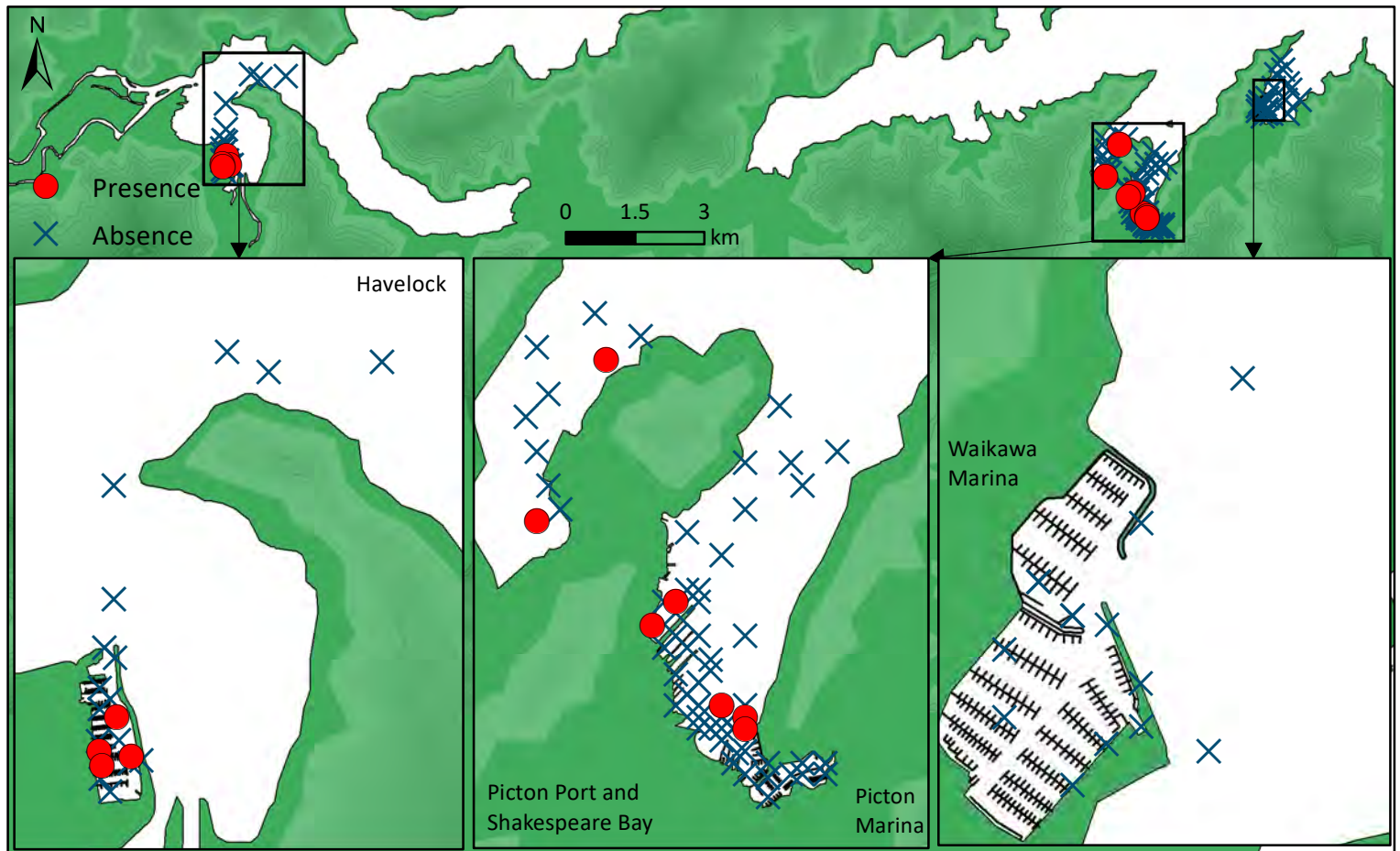
Styela clava



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

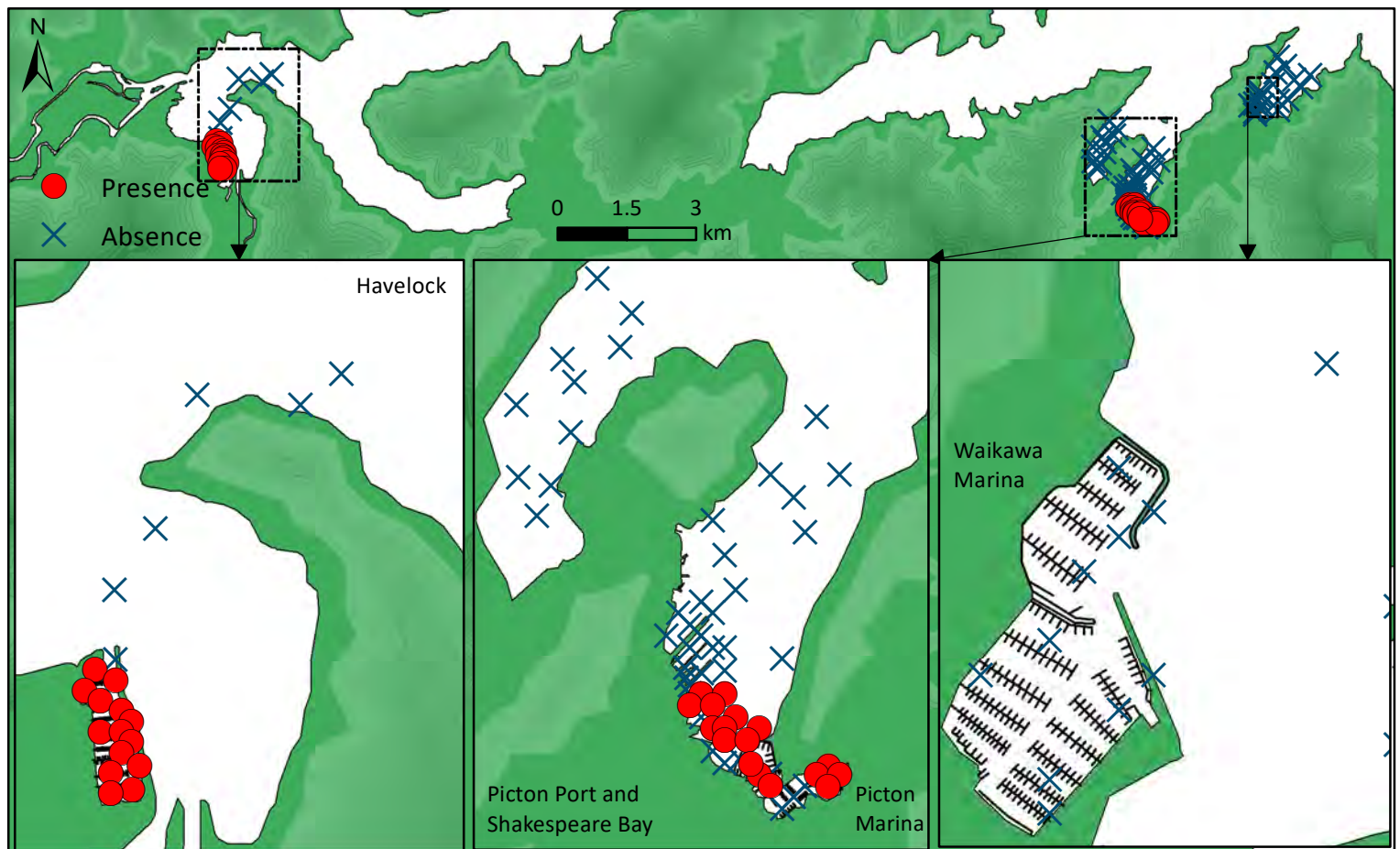
Theora lubrica



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

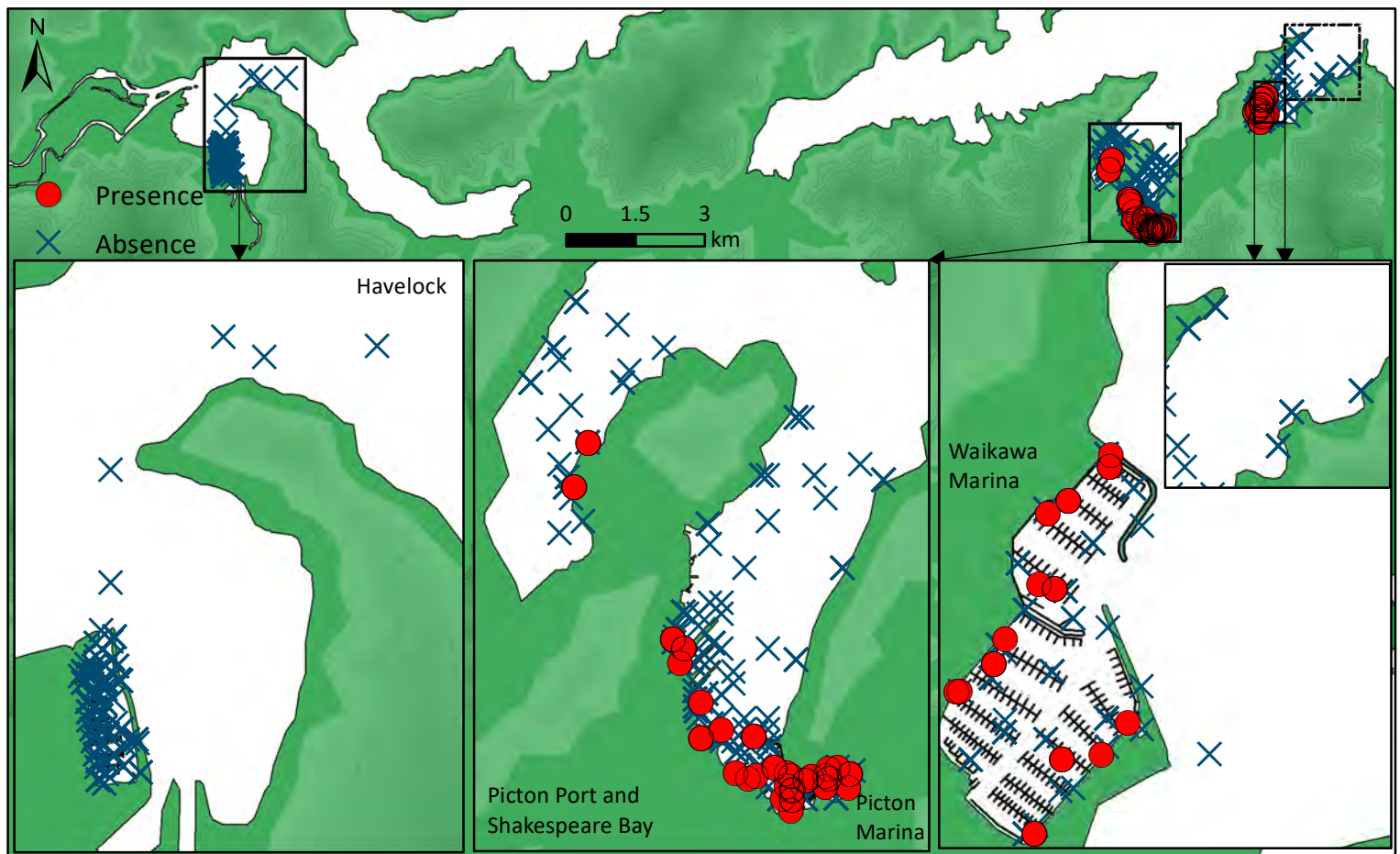
Theora lubrica



Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Winter 2017

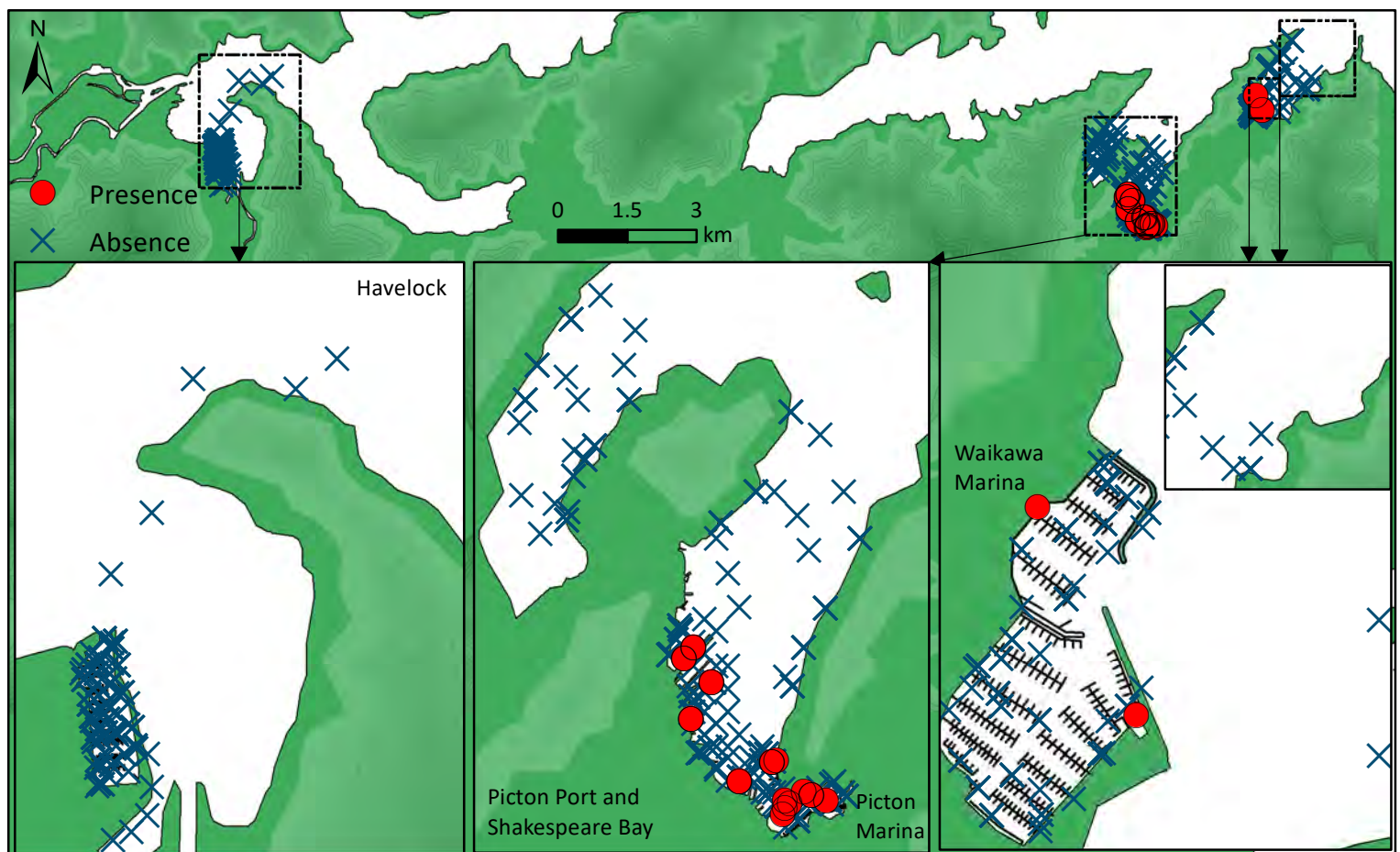
Undaria pinnatifida



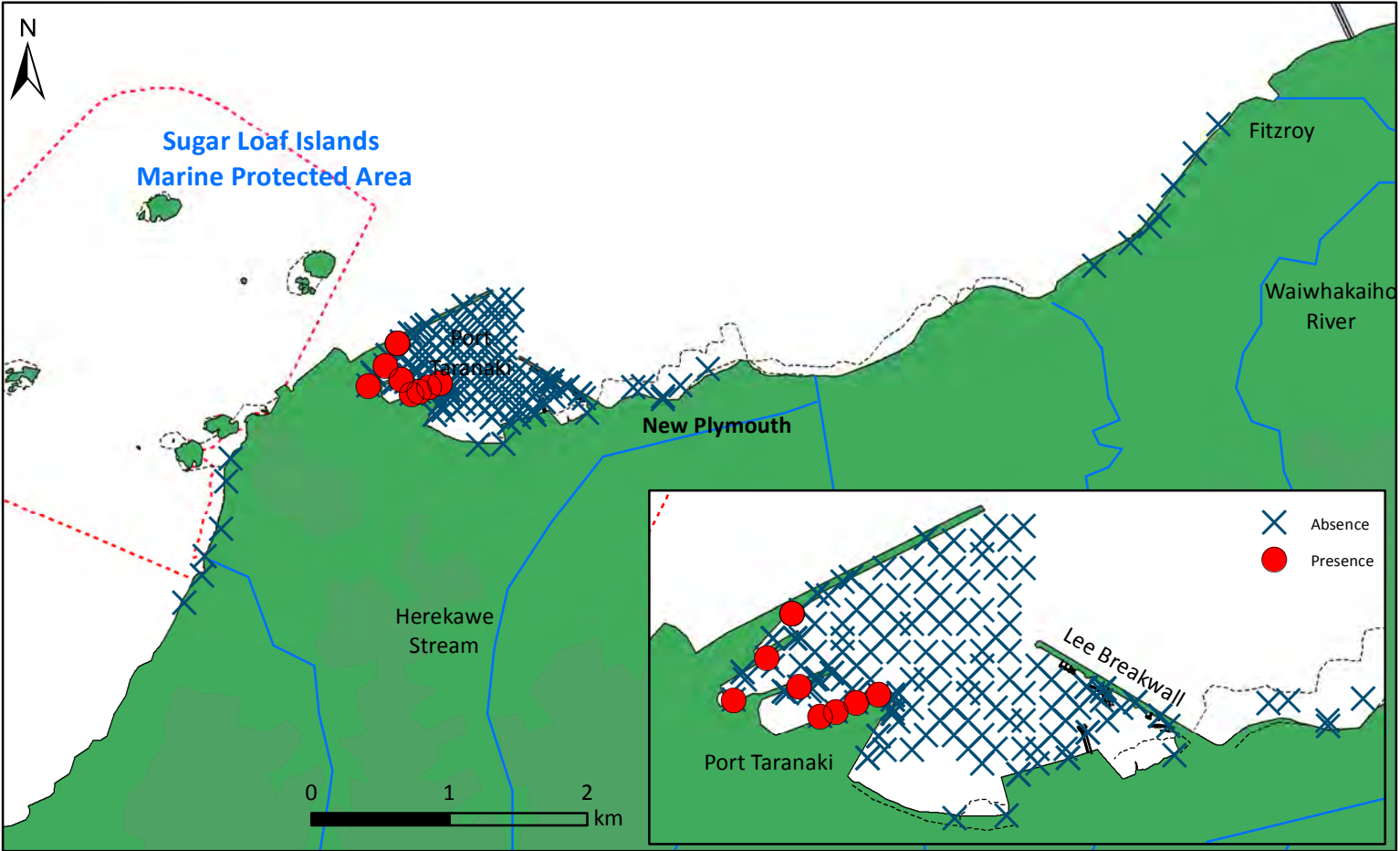
Picton Harbour, Havelock Marina, Port of Picton, Shakespeare Bay and Waikawa Marina

Summer 2017-18

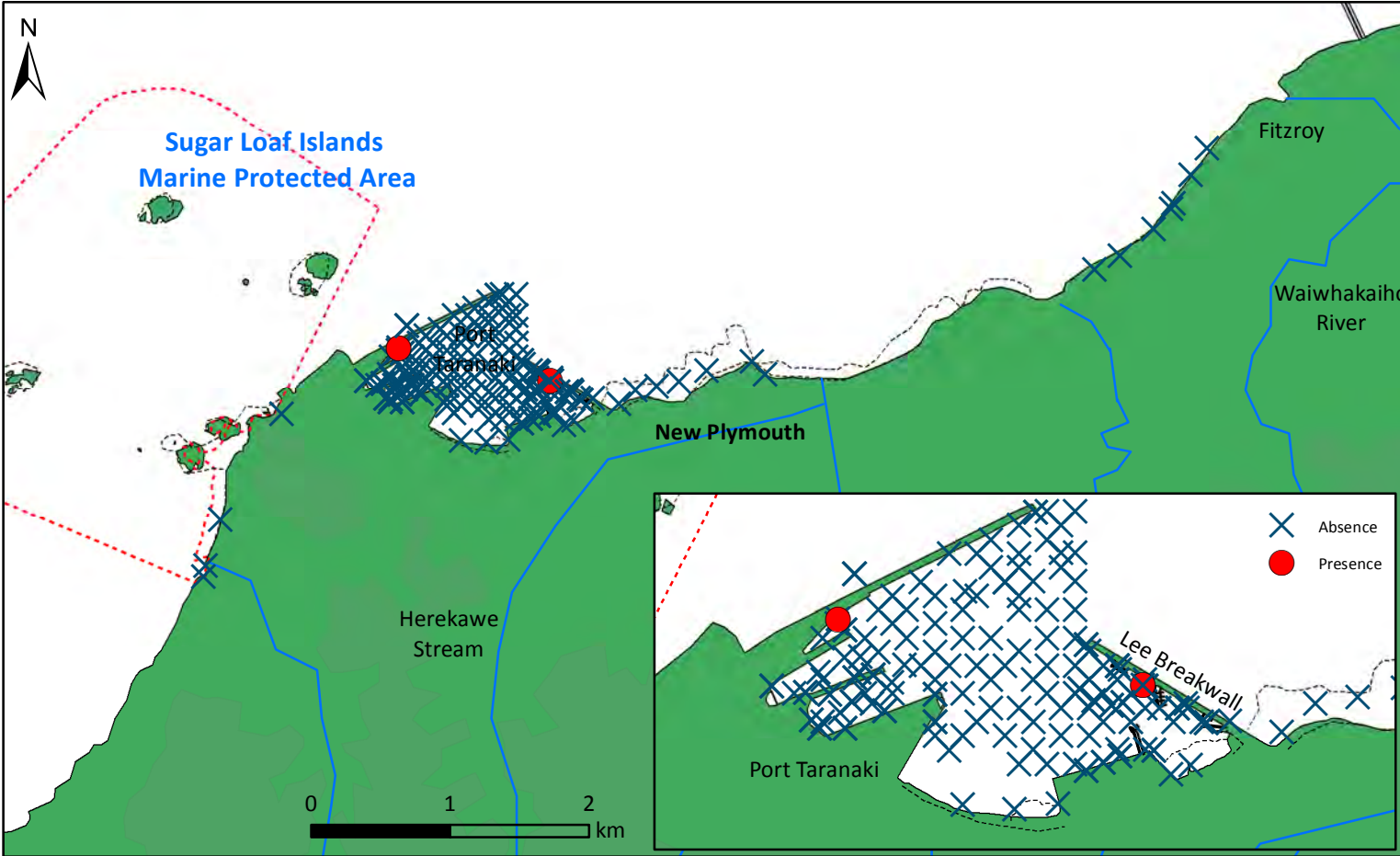
Undaria pinnatifida

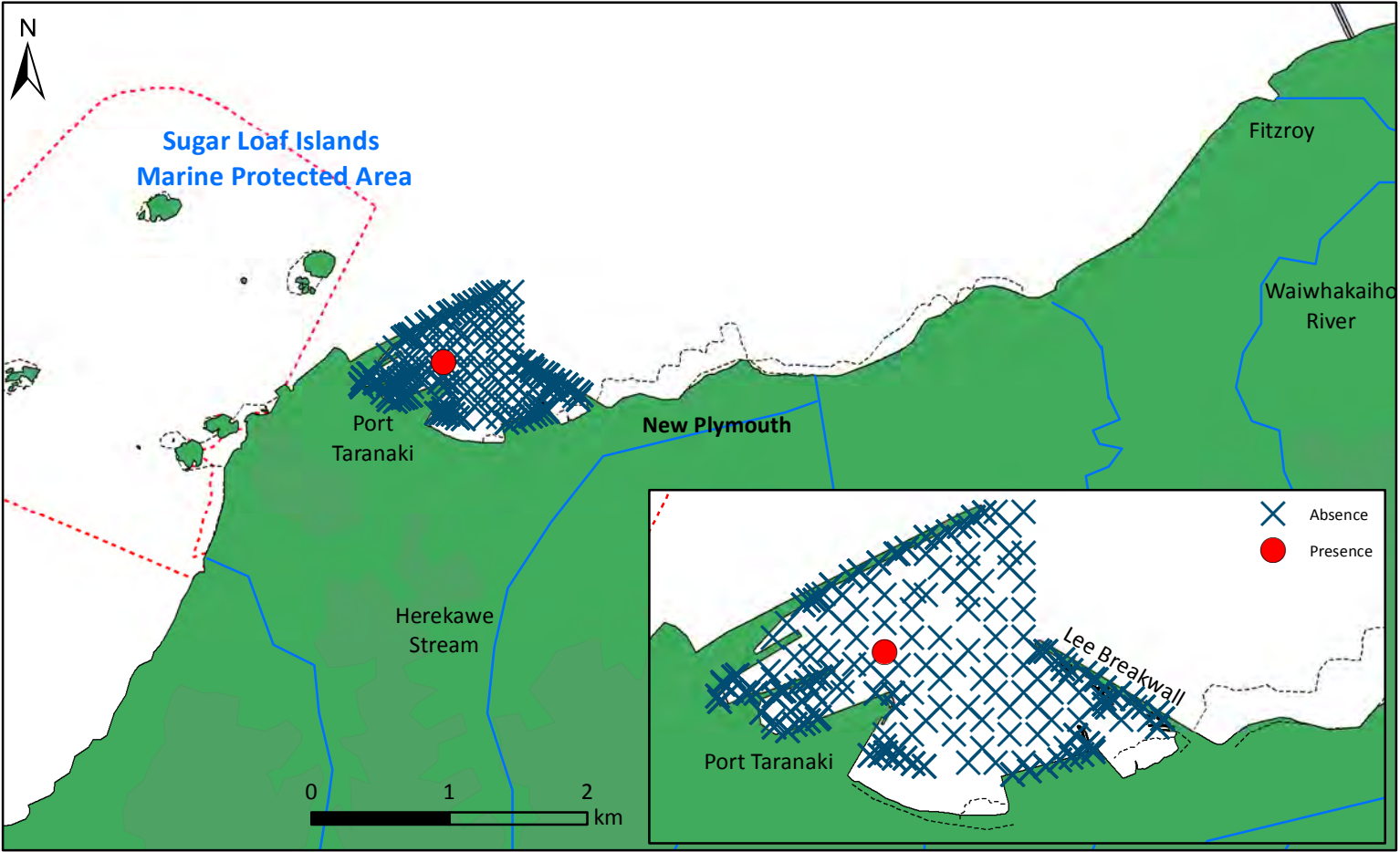


Port Taranaki
Winter 2017
Didemnum vexillum

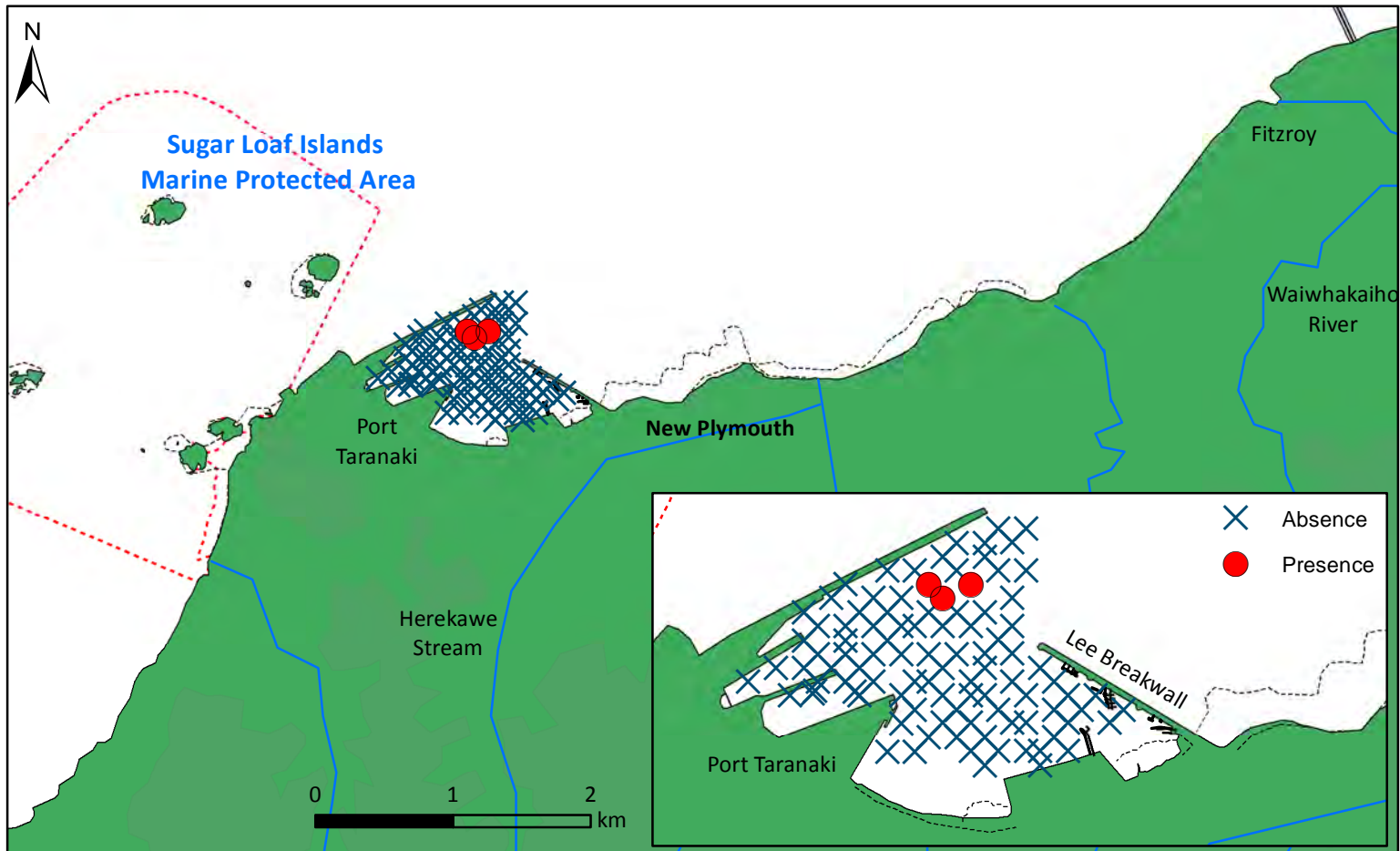


Port Taranaki
Summer 2017-18
Didemnum vexillum

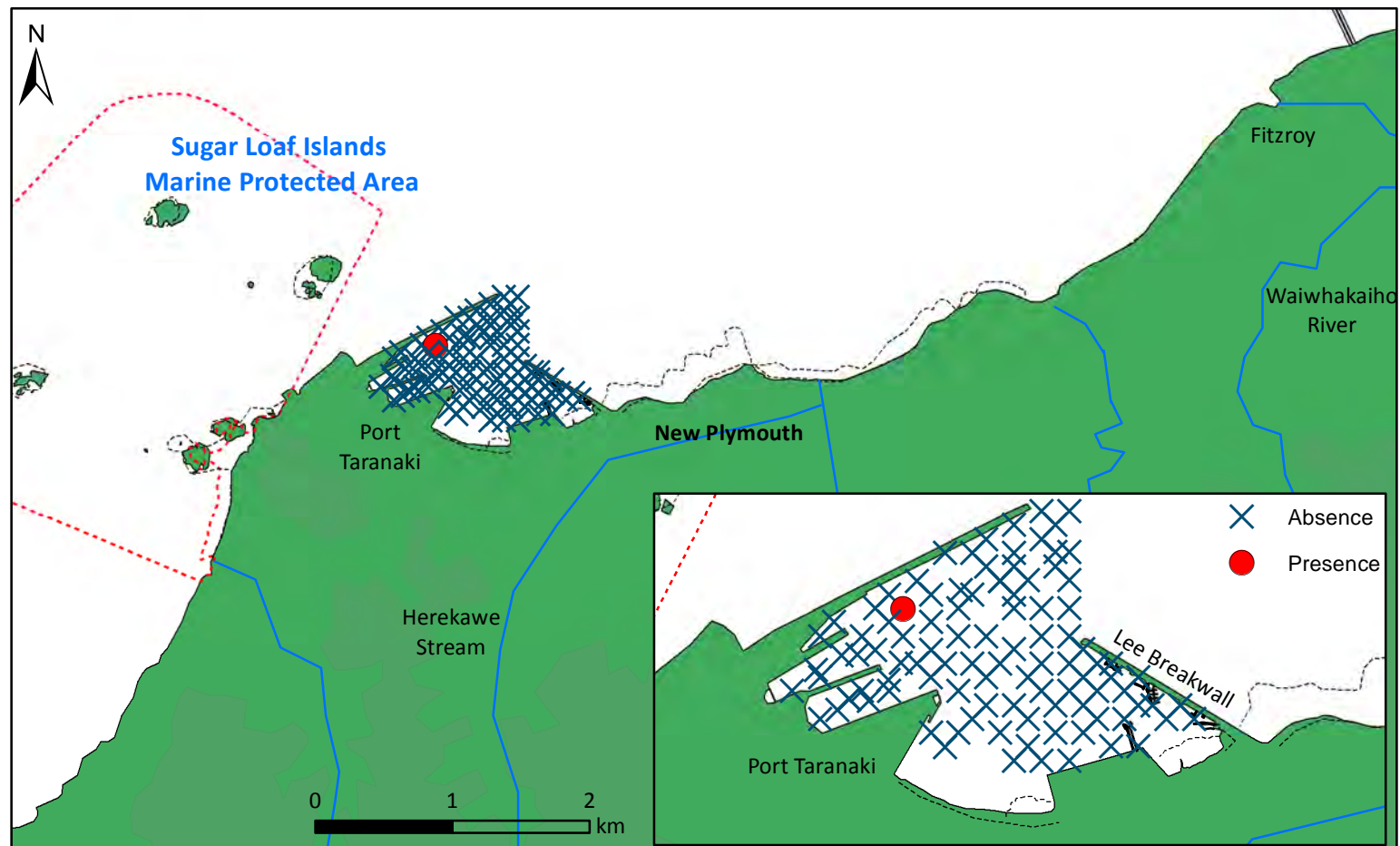




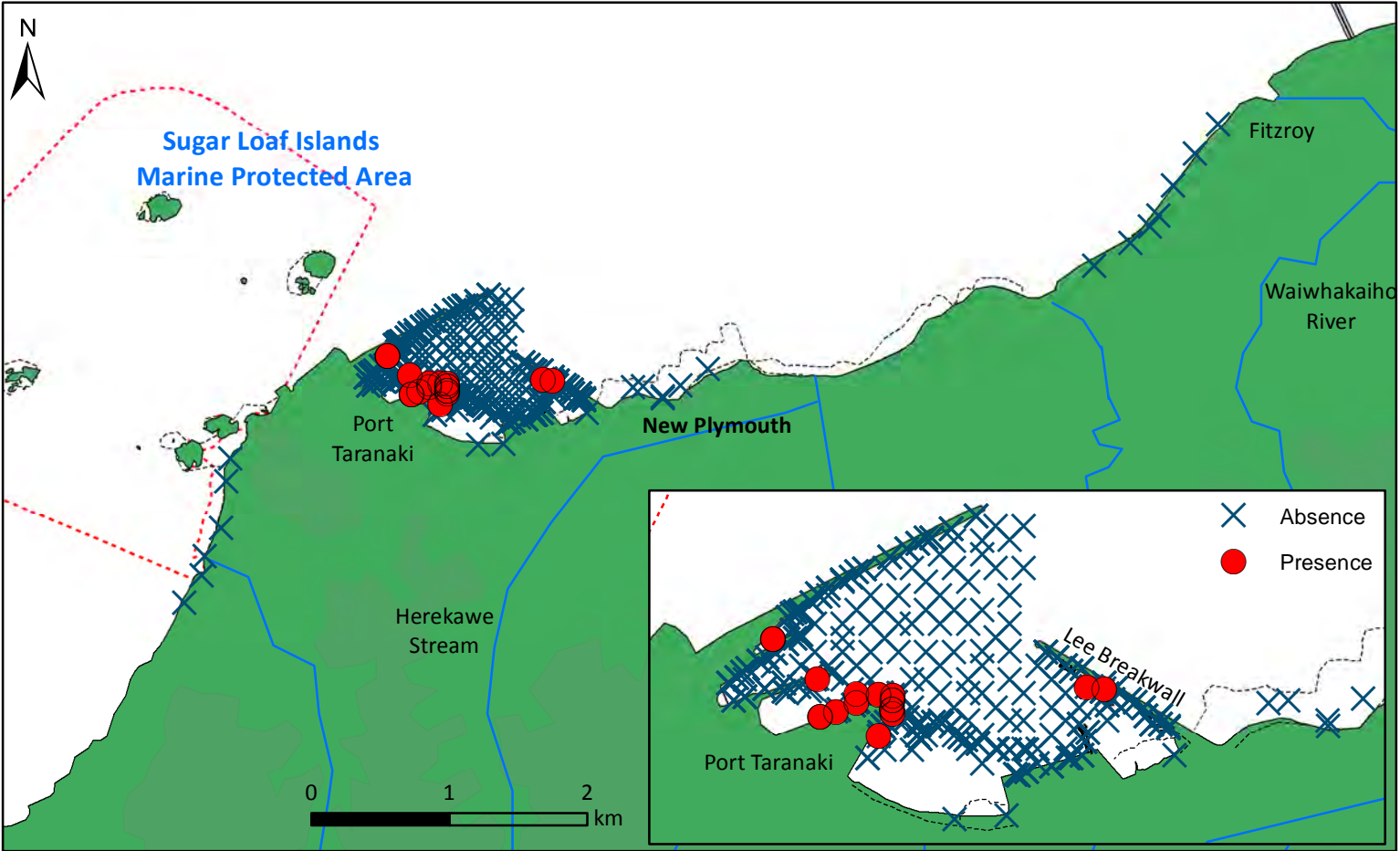
Port Taranaki
Winter 2017
Theora lubrica



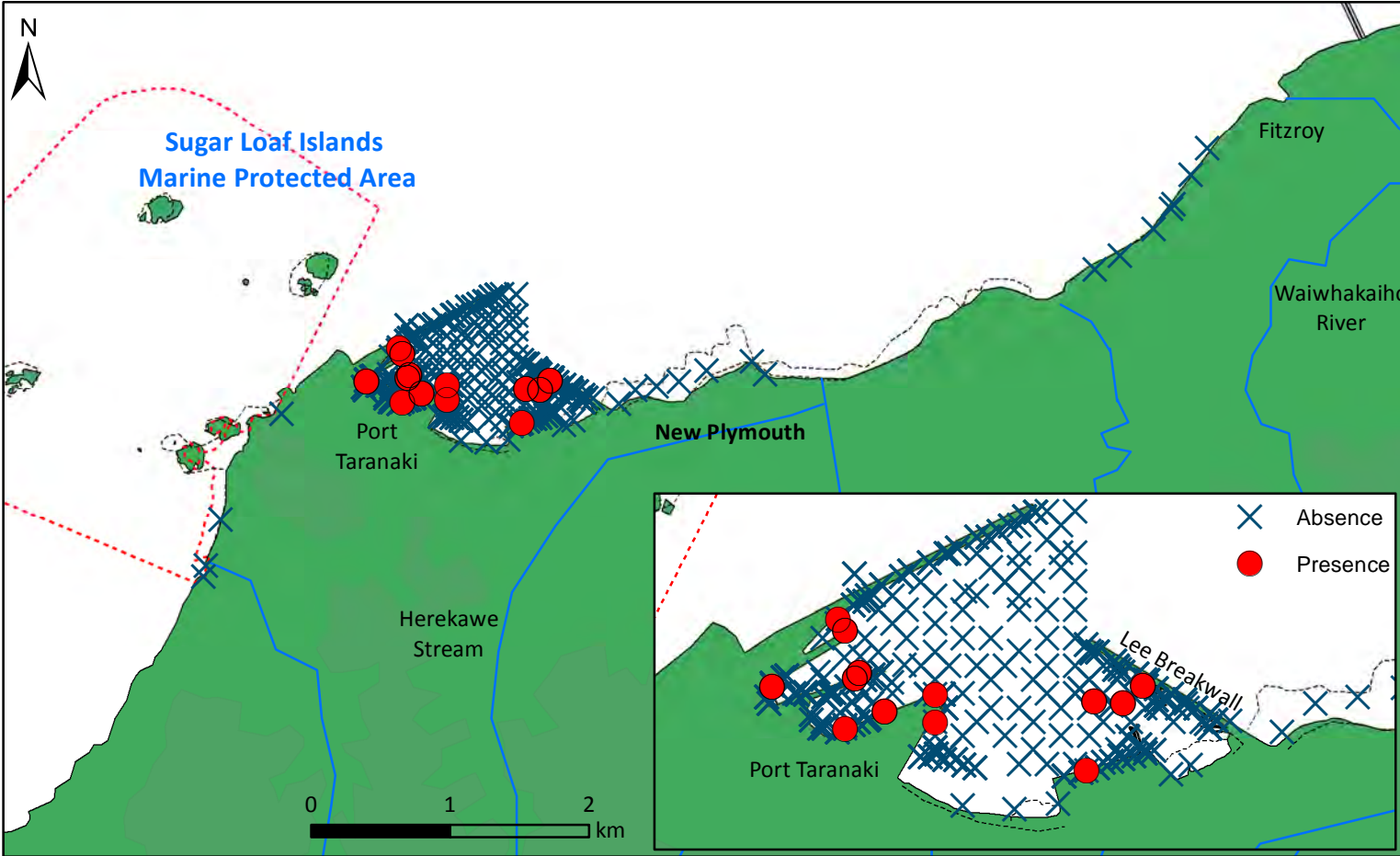
Port Taranaki
Summer 2017-18
Theora lubrica



Port Taranaki
Winter 2017
Undaria pinnatifida



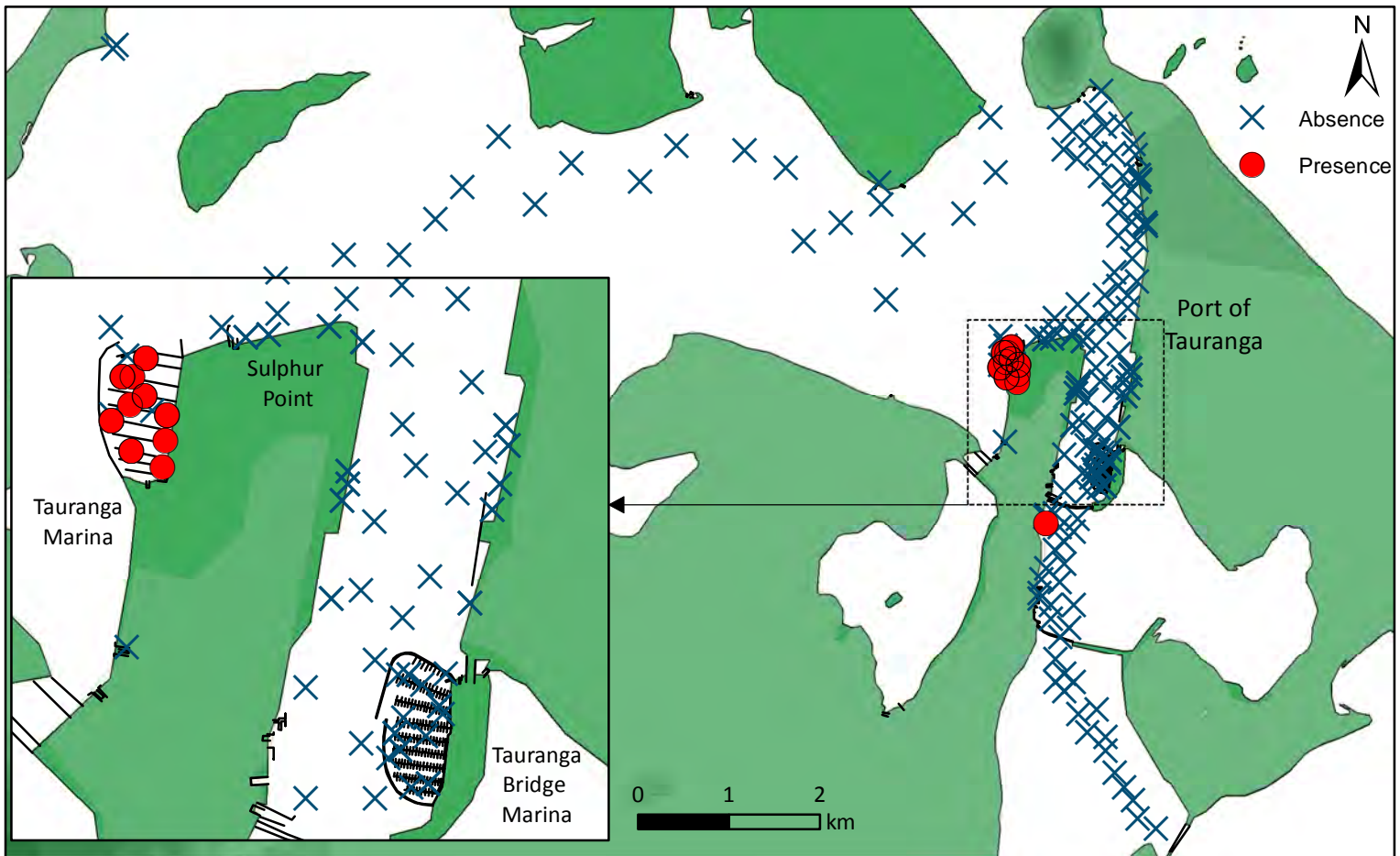
Port Taranaki
Summer 2017-18
Undaria pinnatifida



Tauranga Harbour

Winter 2017

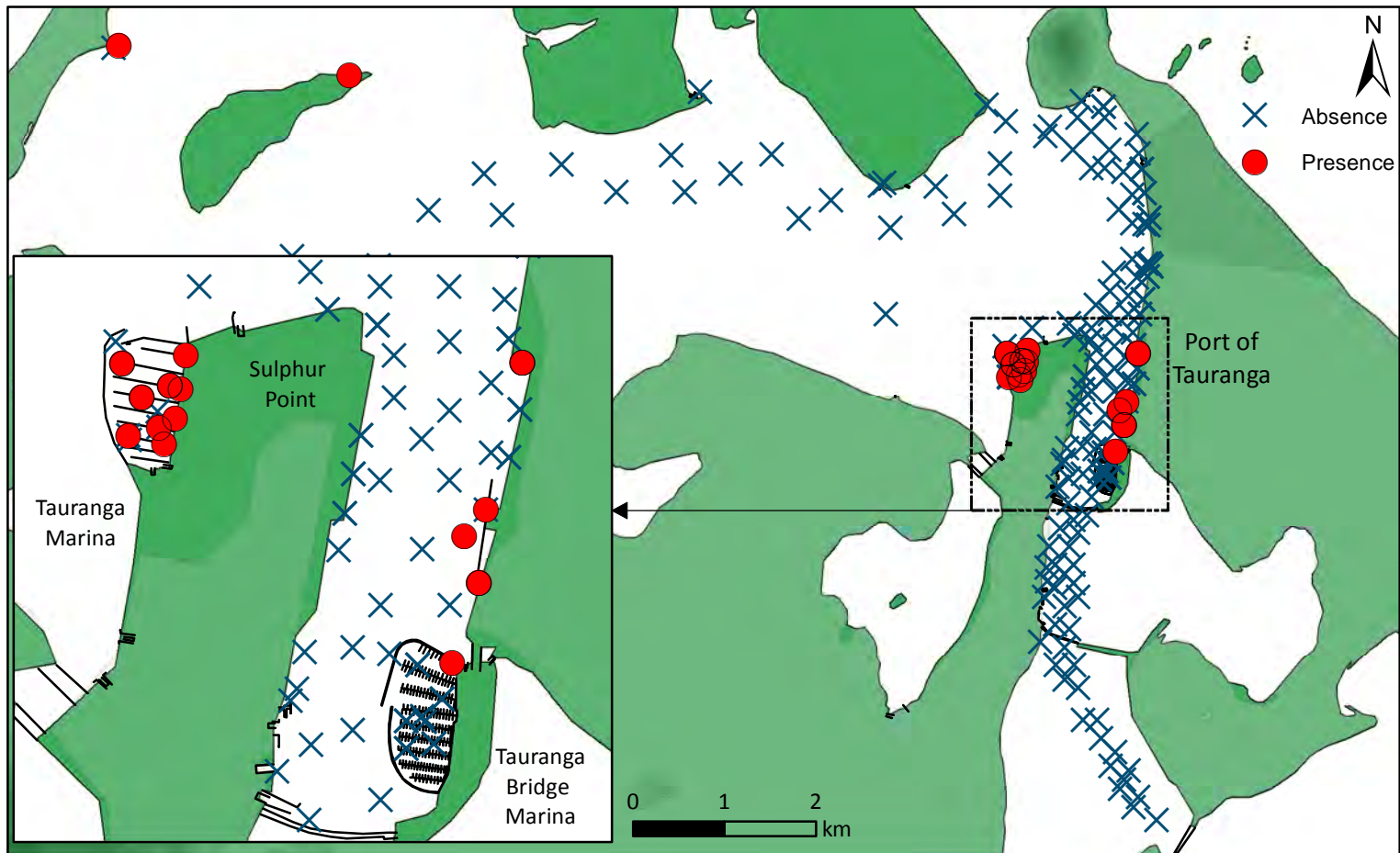
Amathia verticillata



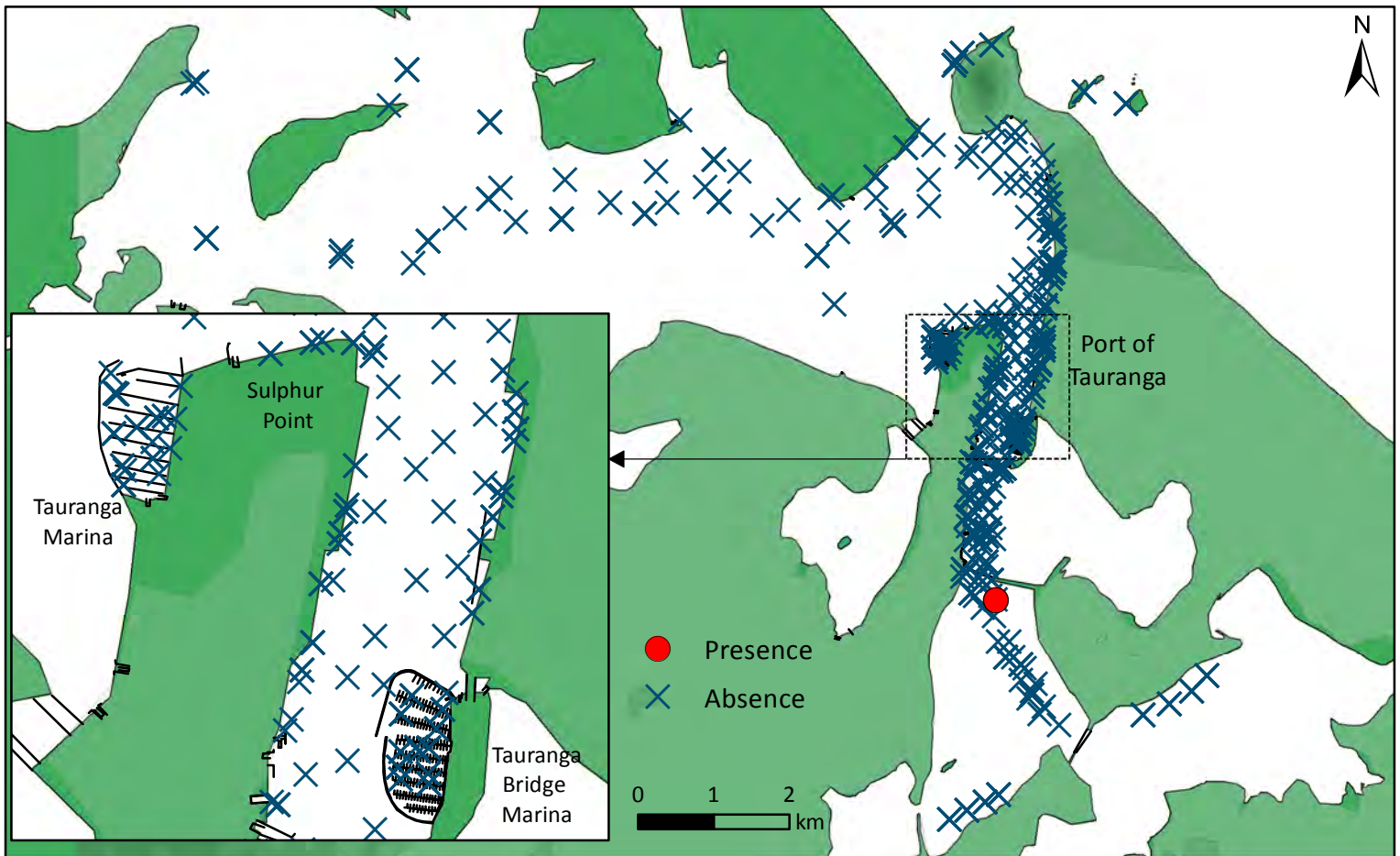
Tauranga Harbour

Summer 2017-18

Amathia verticillata



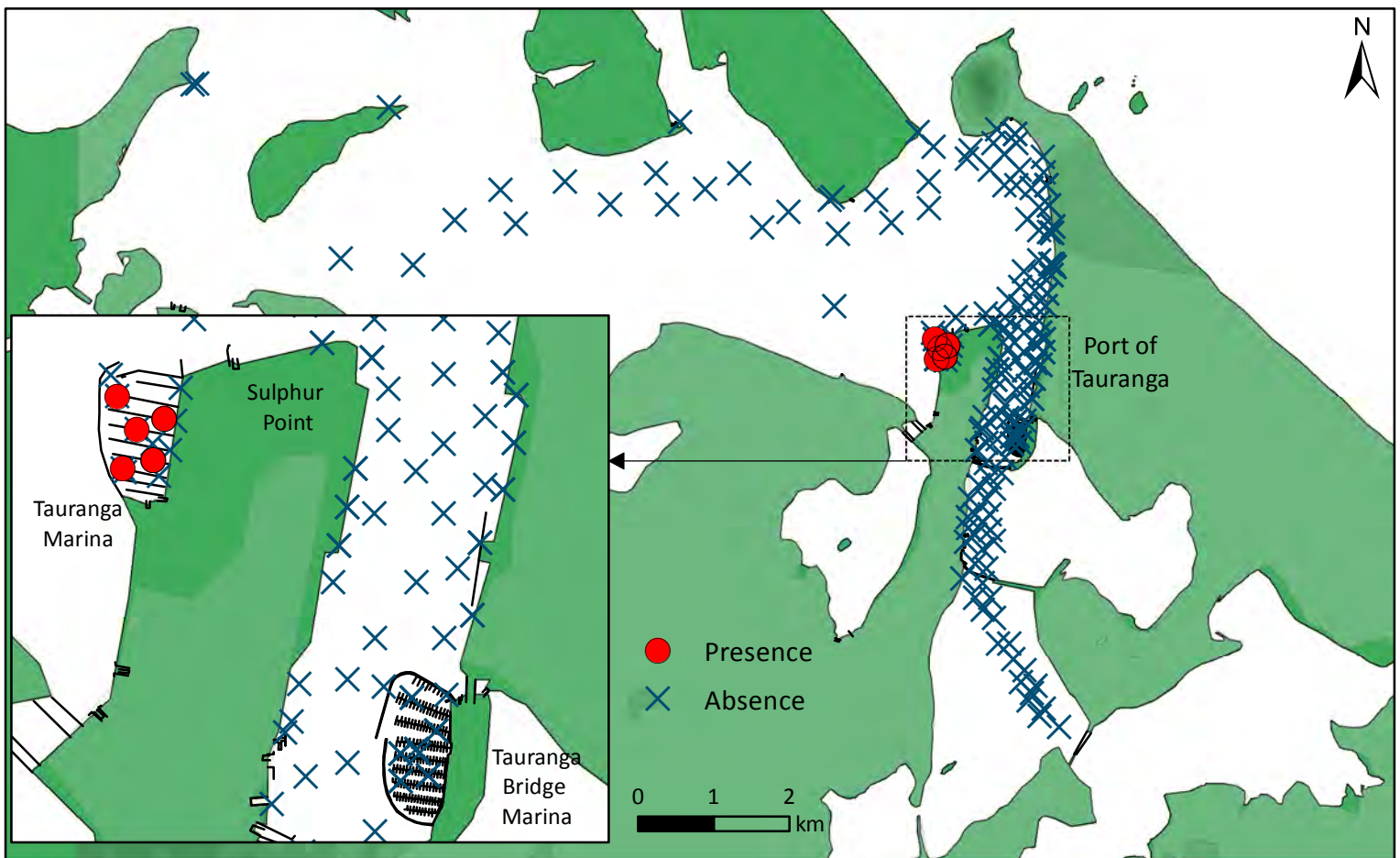
Tauranga Harbour
Summer 2017-18
Charybdis (Charybdis) japonica



Tauranga Harbour

Summer 2017-18

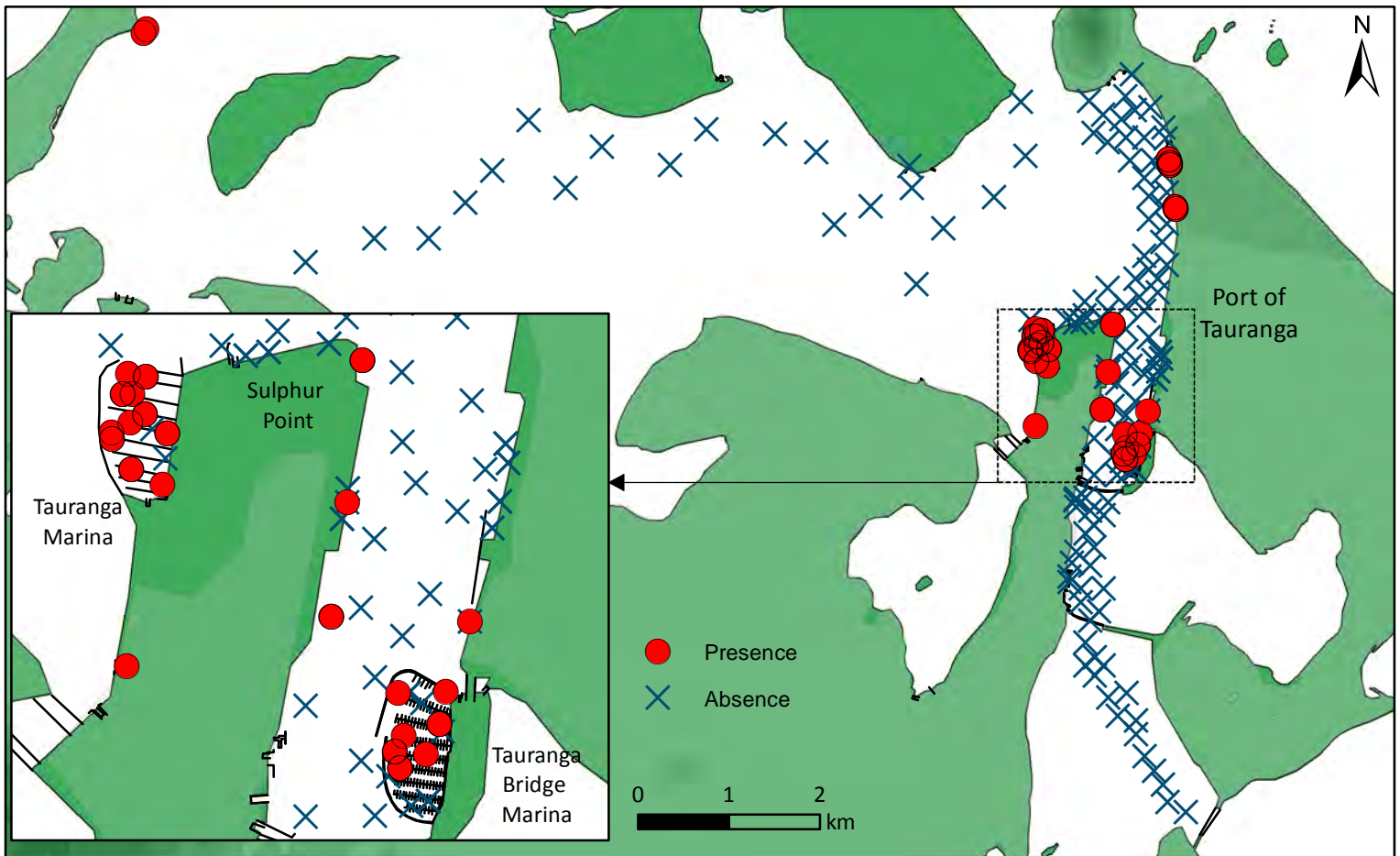
Ciona spp.



Tauranga Harbour

Winter 2017

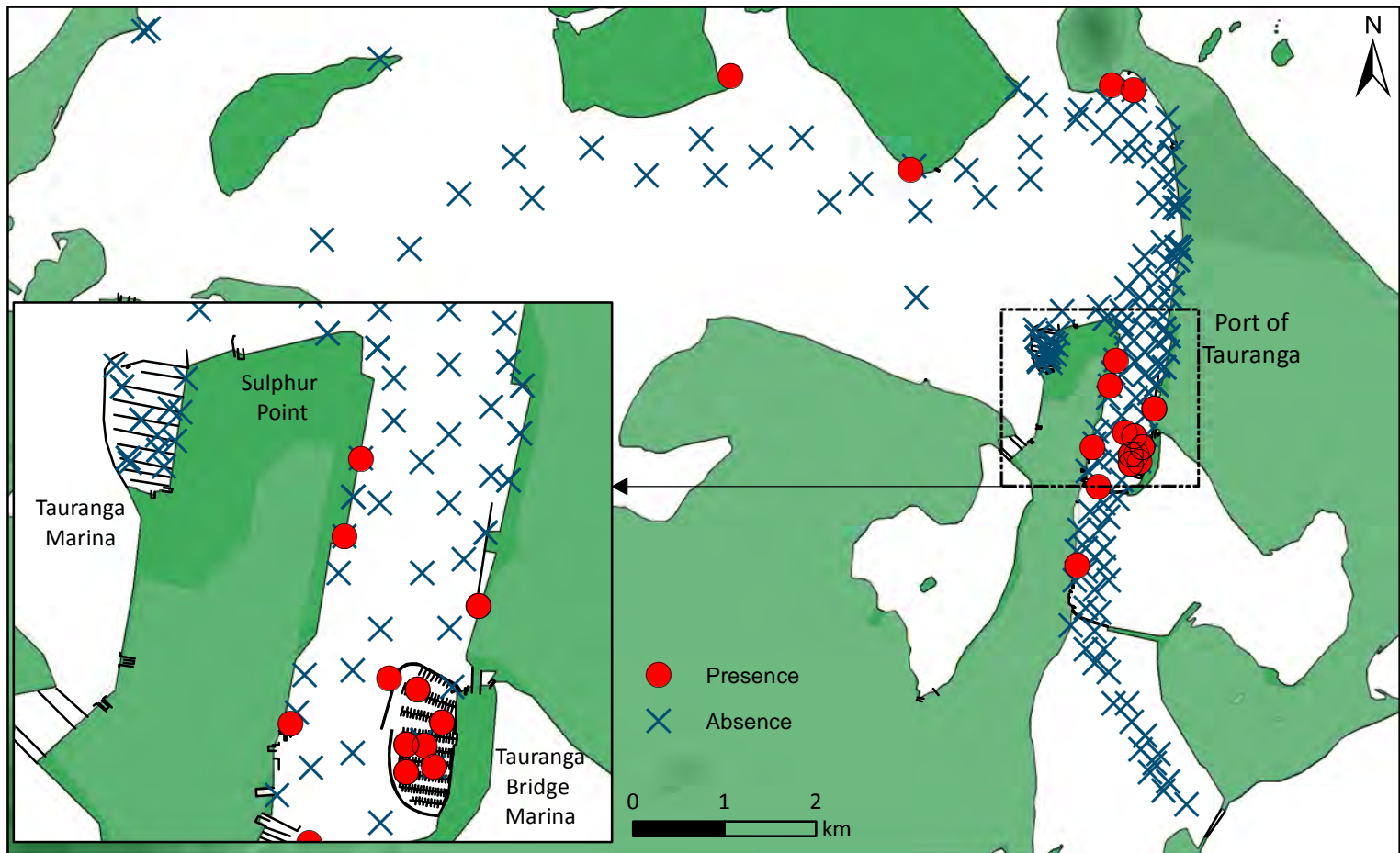
Didemnum vexillum



Tauranga Harbour

Summer 2017-18

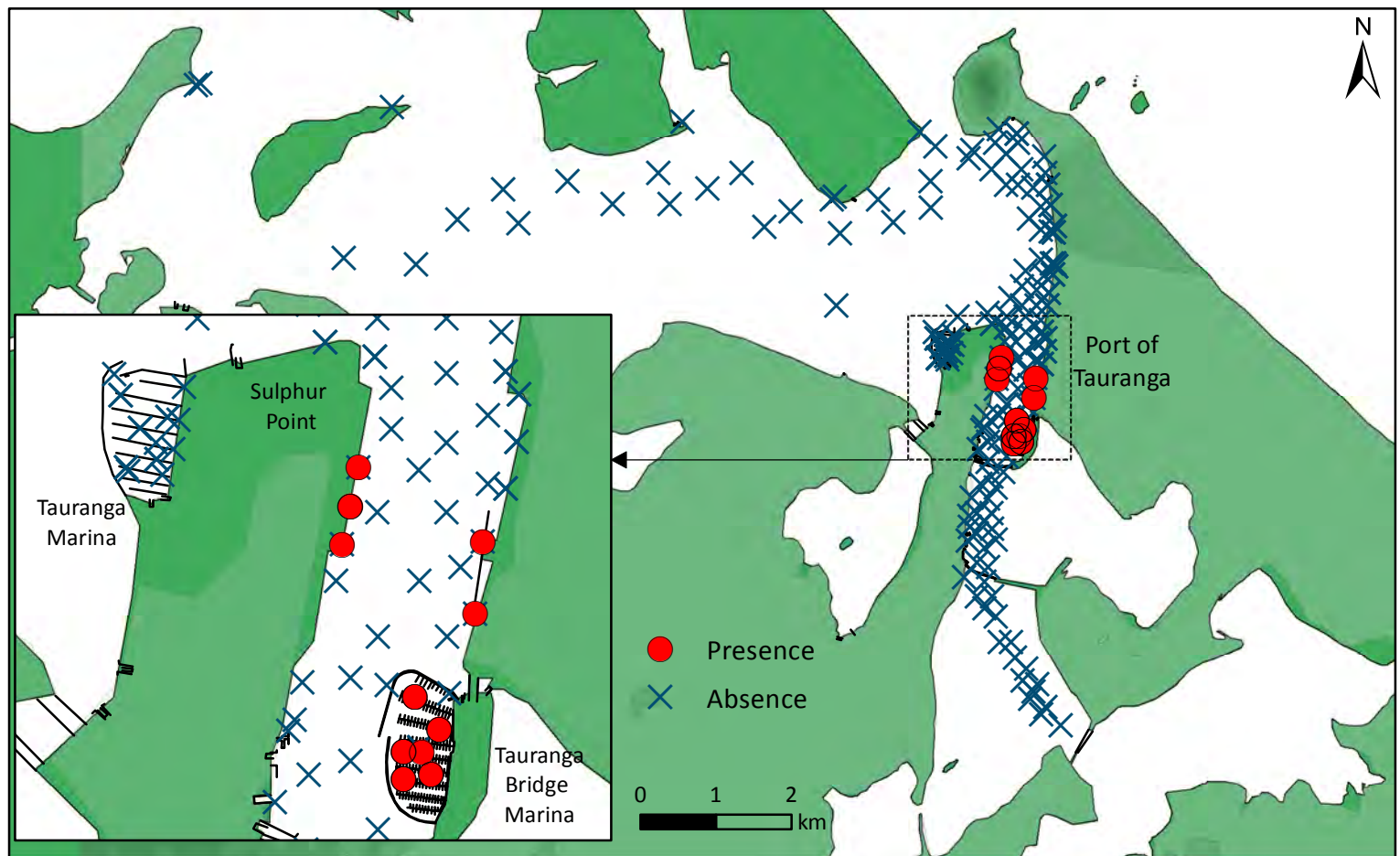
Didemnum vexillum



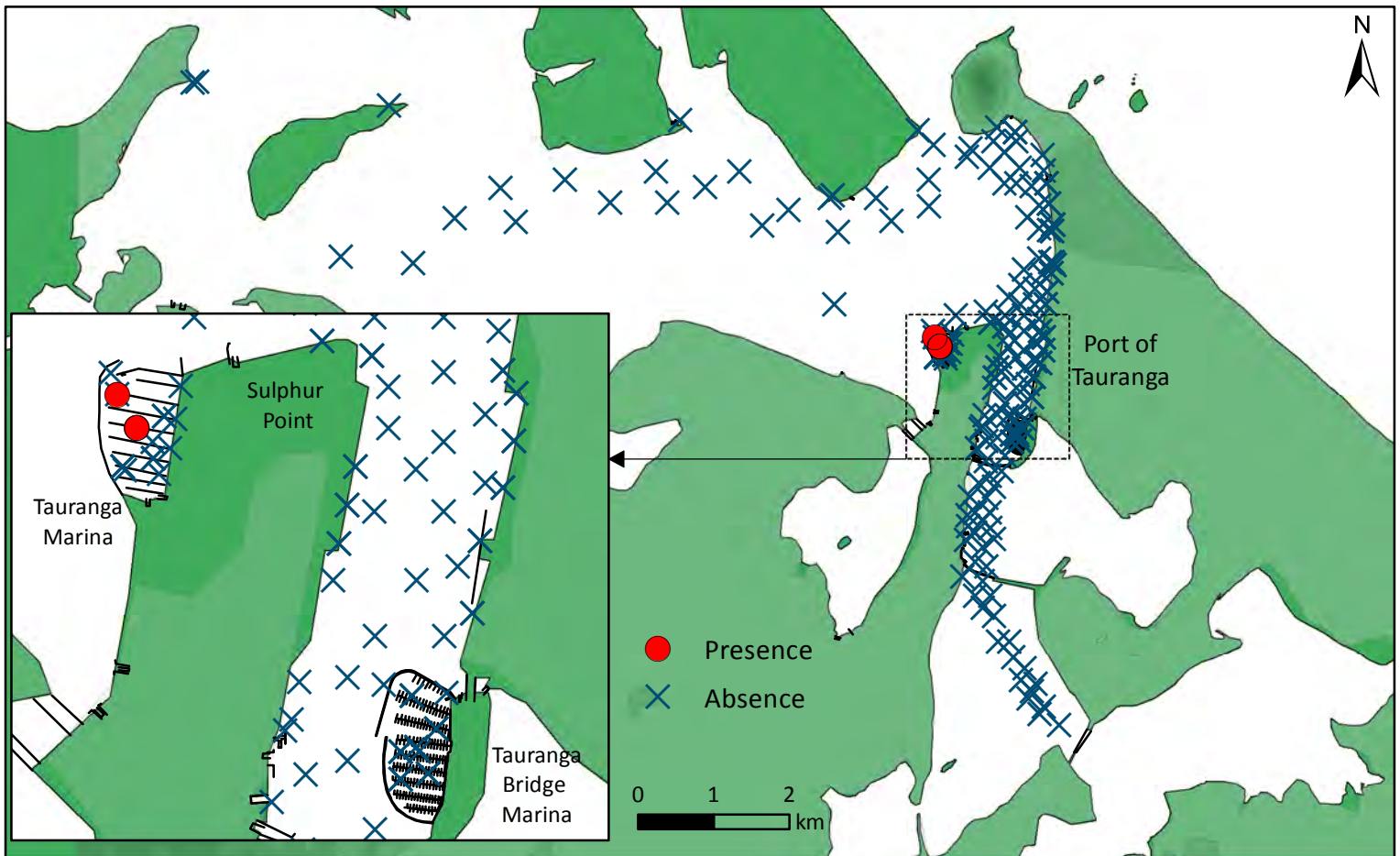
Tauranga Harbour

Summer 2017-18

Ectopleura spp.



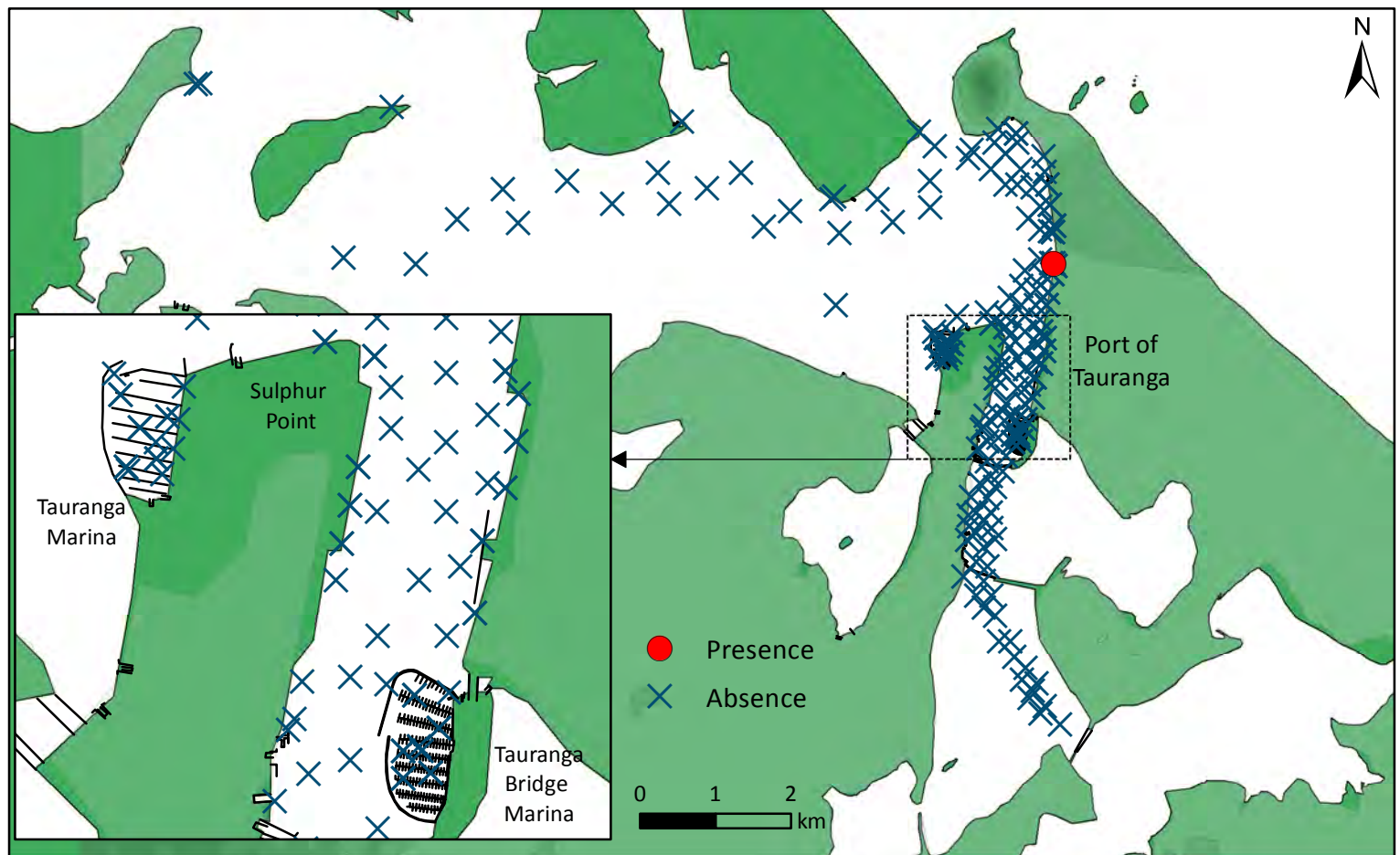
Tauranga Harbour
Summer 2017-18
Polyandrocarpa zorritensis



Tauranga Harbour

Summer 2017-18

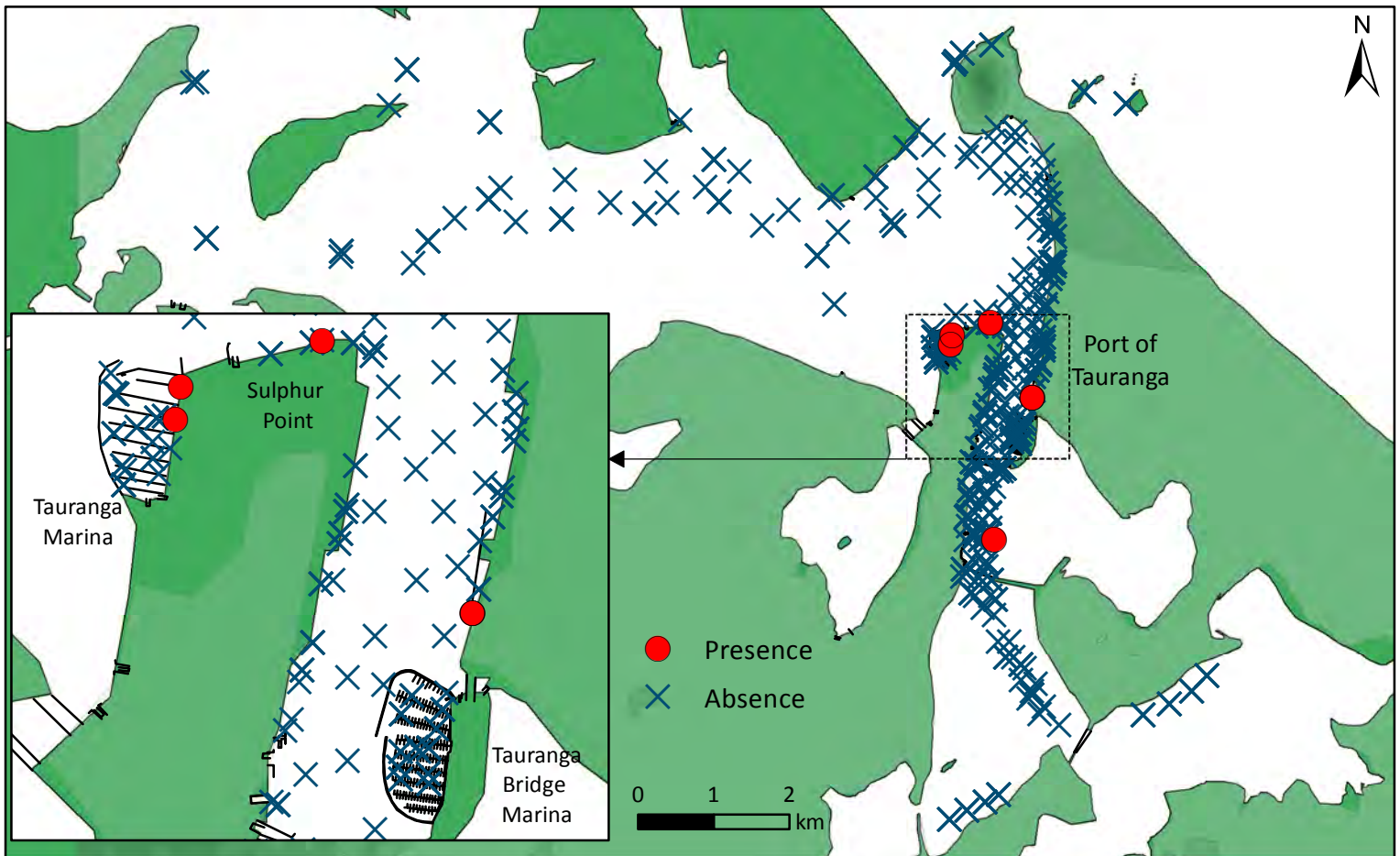
Polycera hedgpethi



Tauranga Harbour

Summer 2017-18

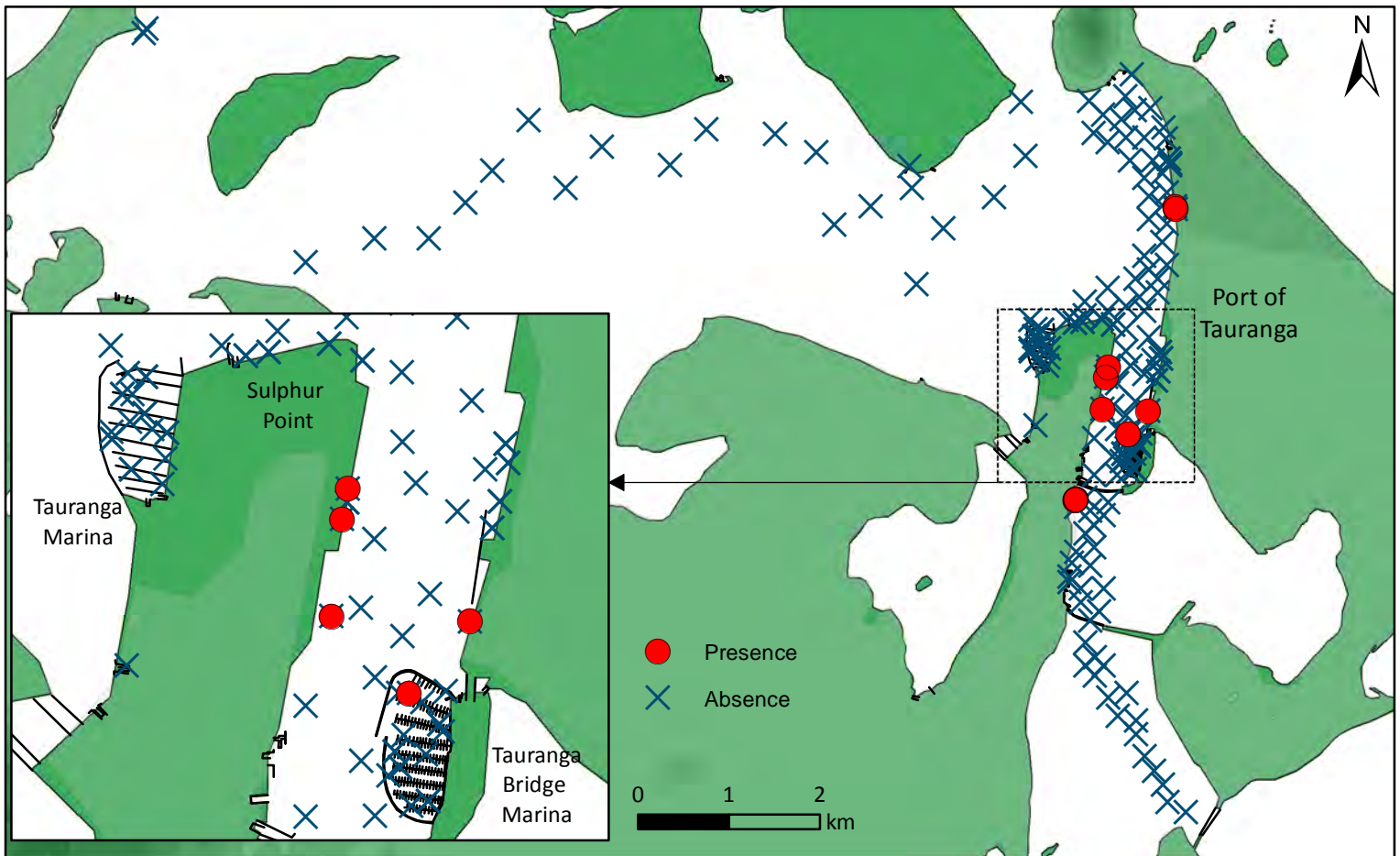
Pyromaia tuberculata



Tauranga Harbour

Winter 2017

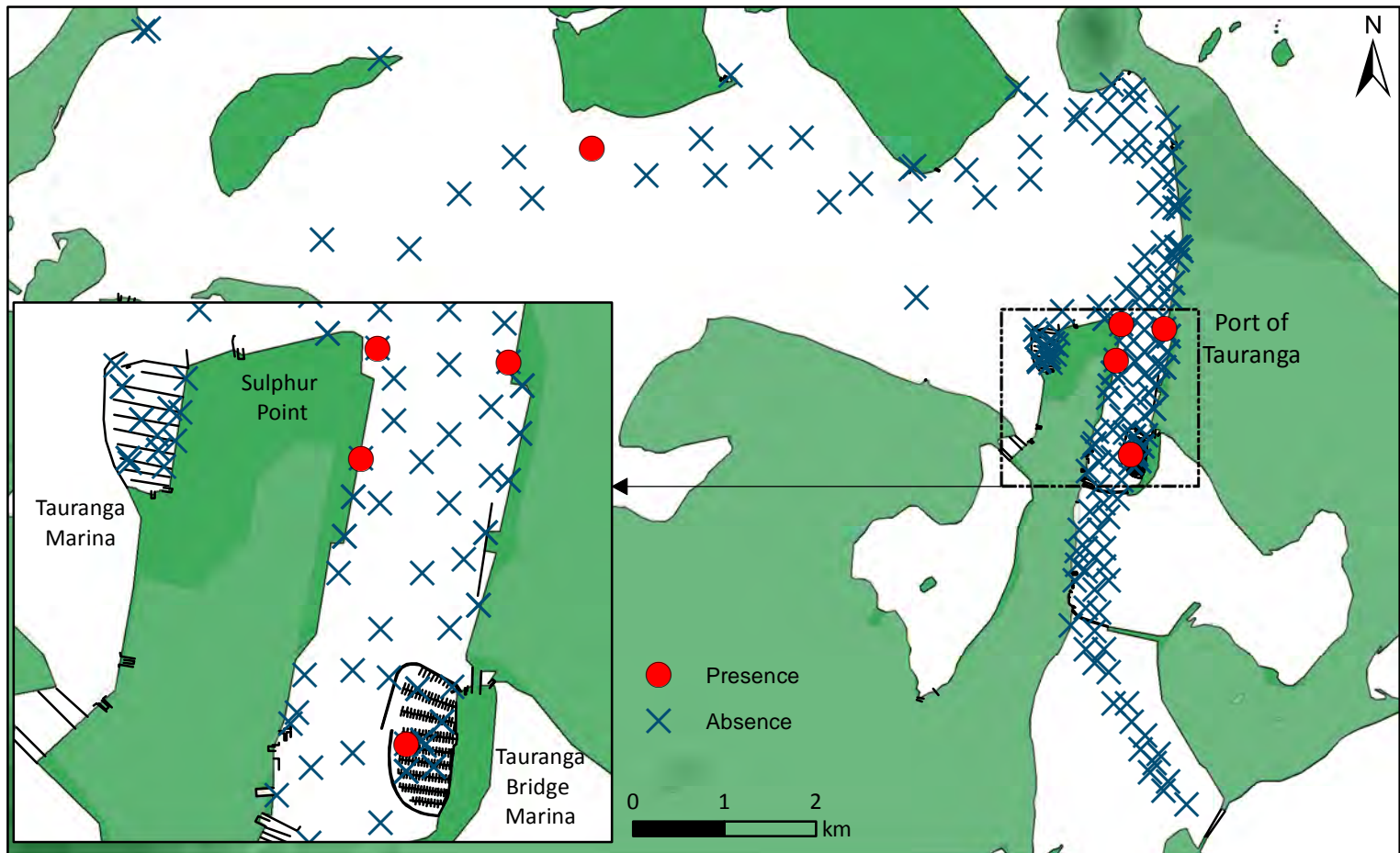
Styela clava



Tauranga Harbour

Summer 2017-18

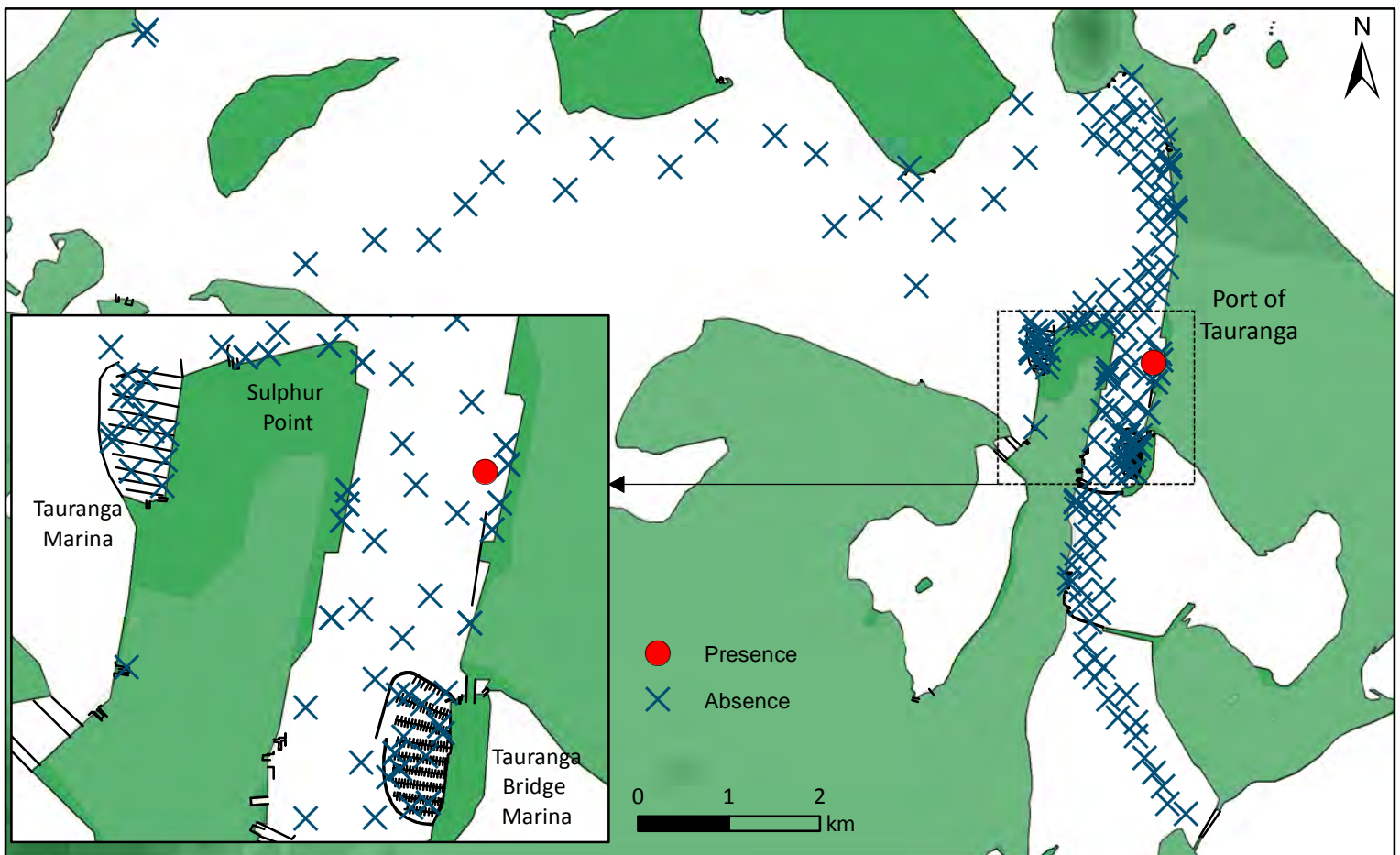
Styela clava



Tauranga Harbour

Winter 2017

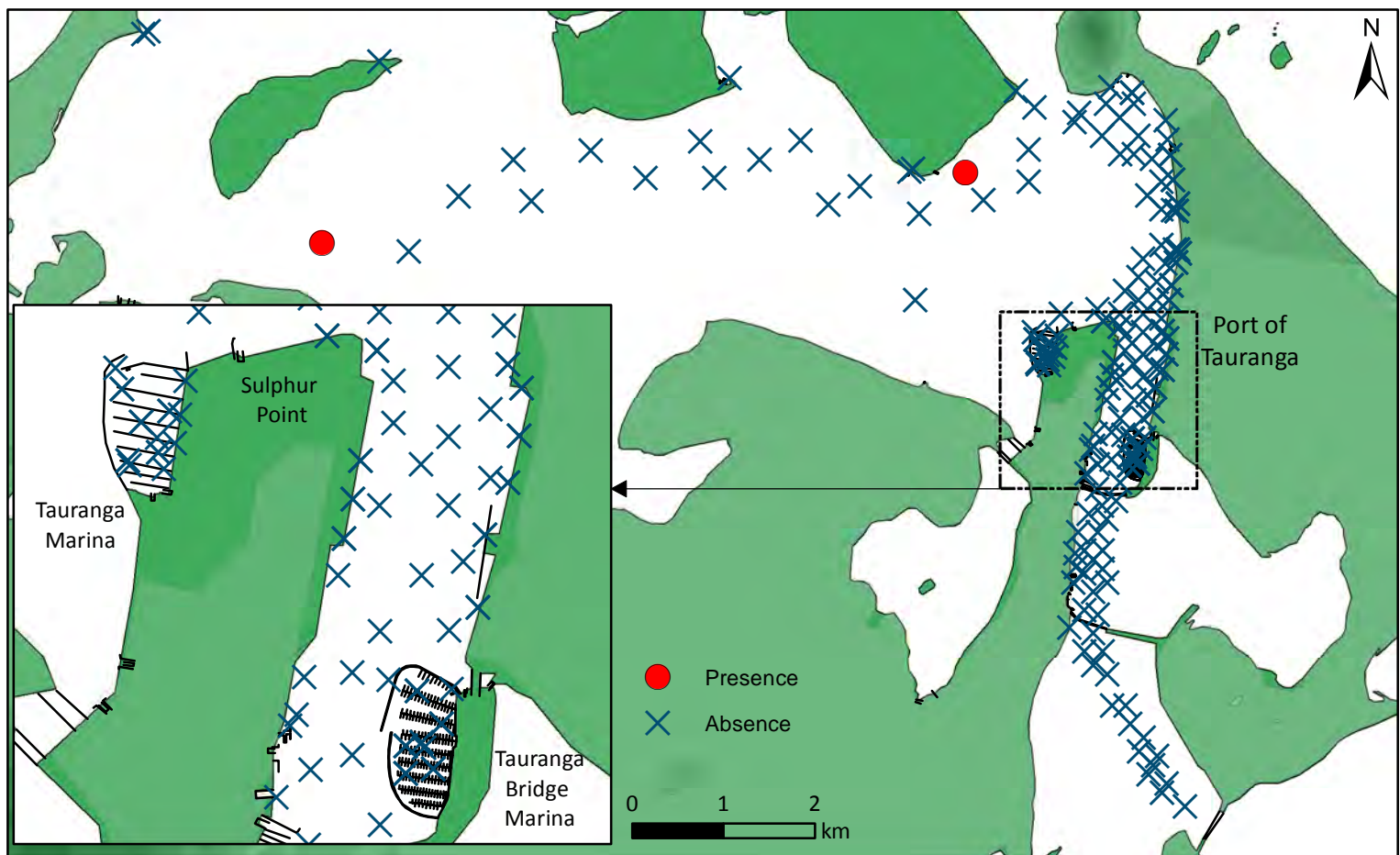
Theora lubrica



Tauranga Harbour

Summer 2017-18

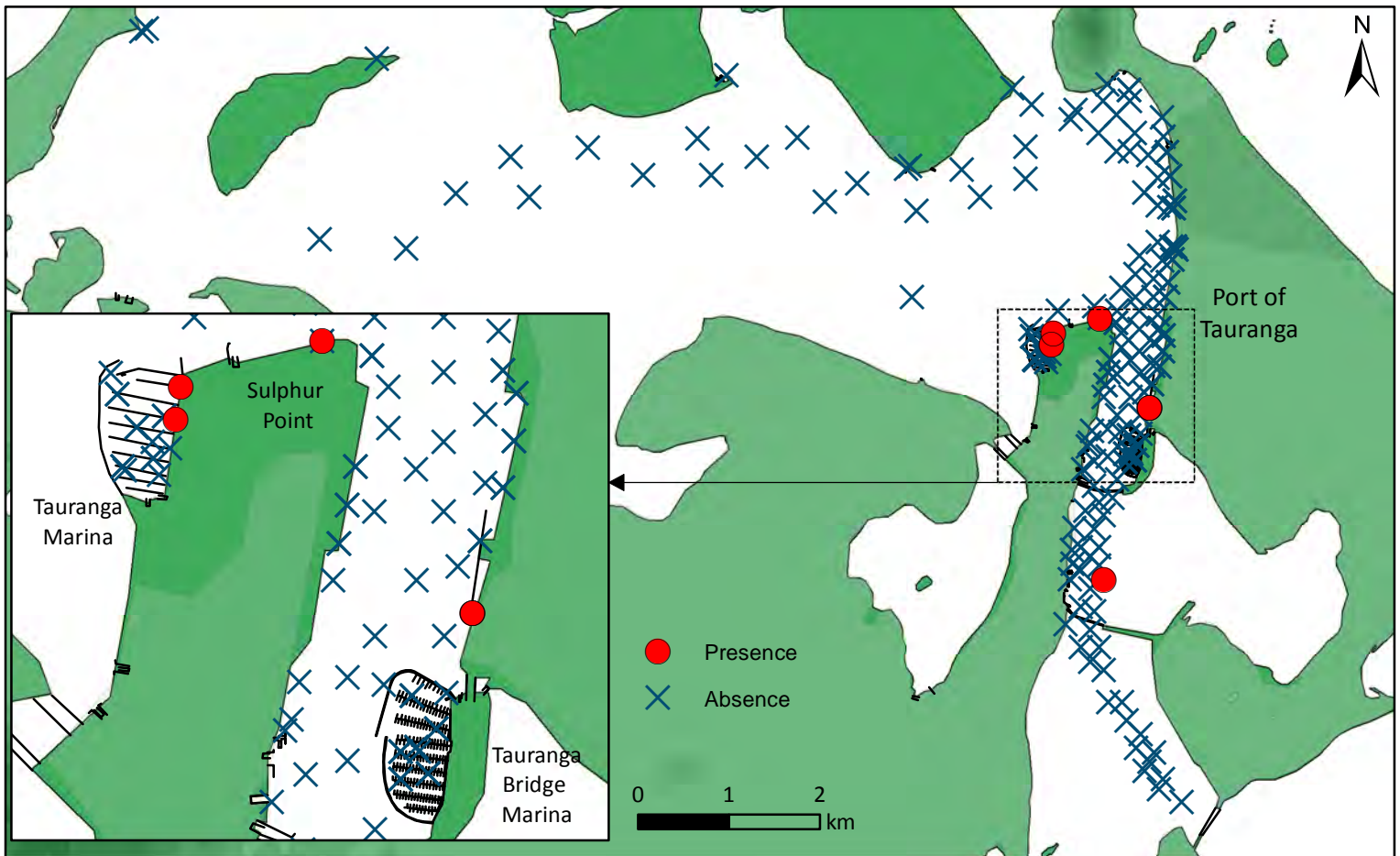
Theora lubrica



Tauranga Harbour

Summer 2017-18

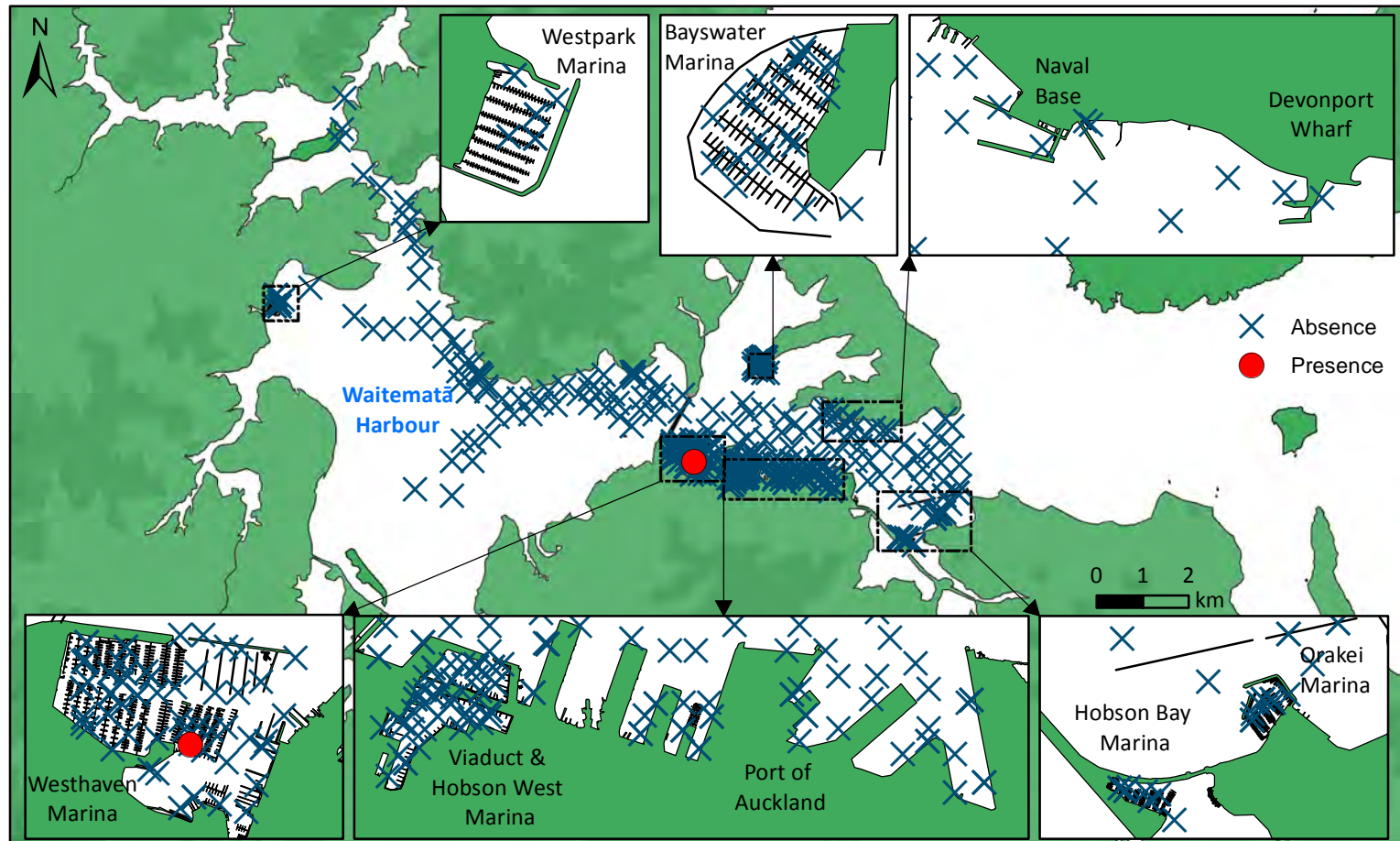
Undaria pinnatifida



Waitematā Harbour

Summer 2017-18

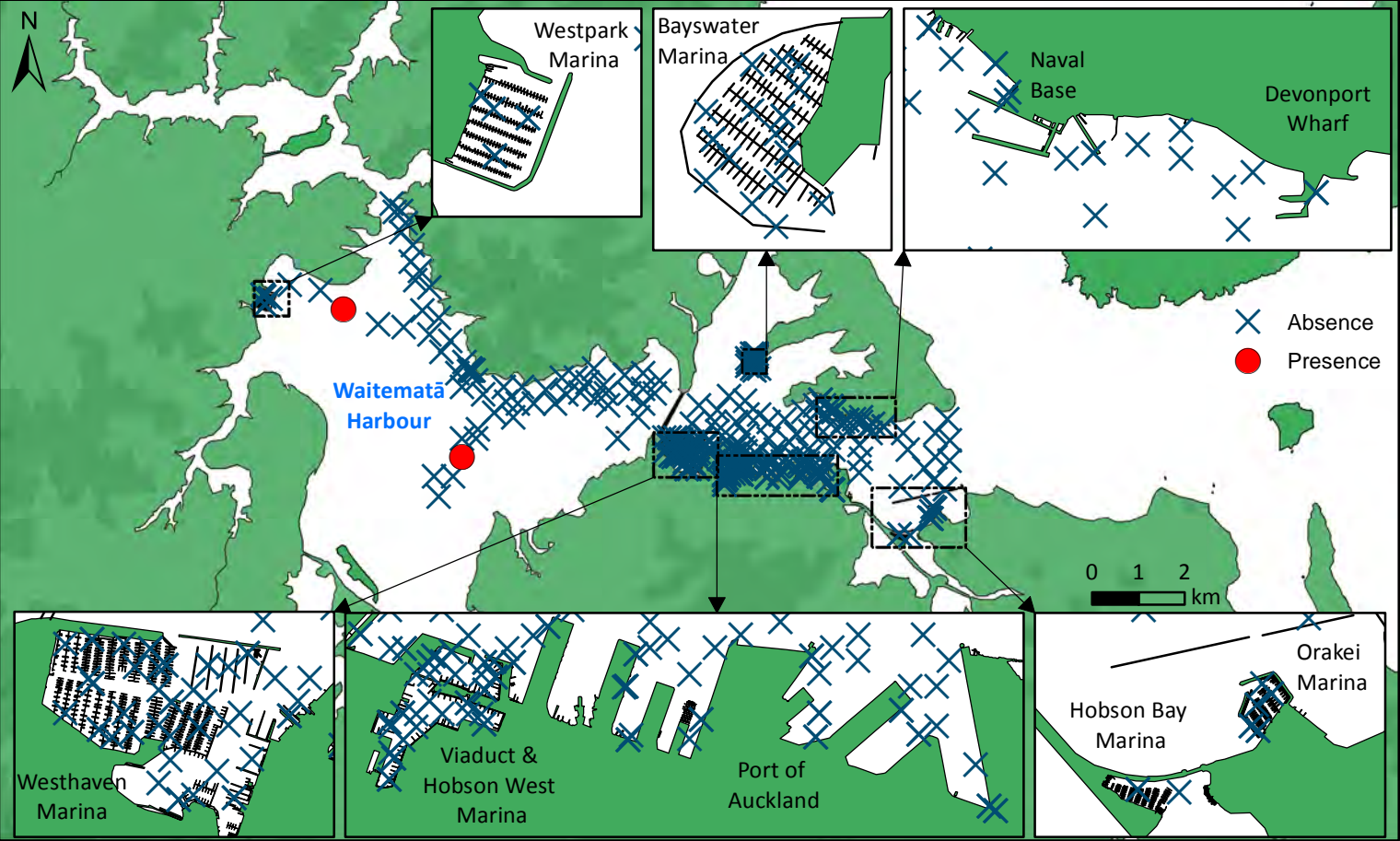
Amathia verticillata



Waitematā Harbour

Winter 2017

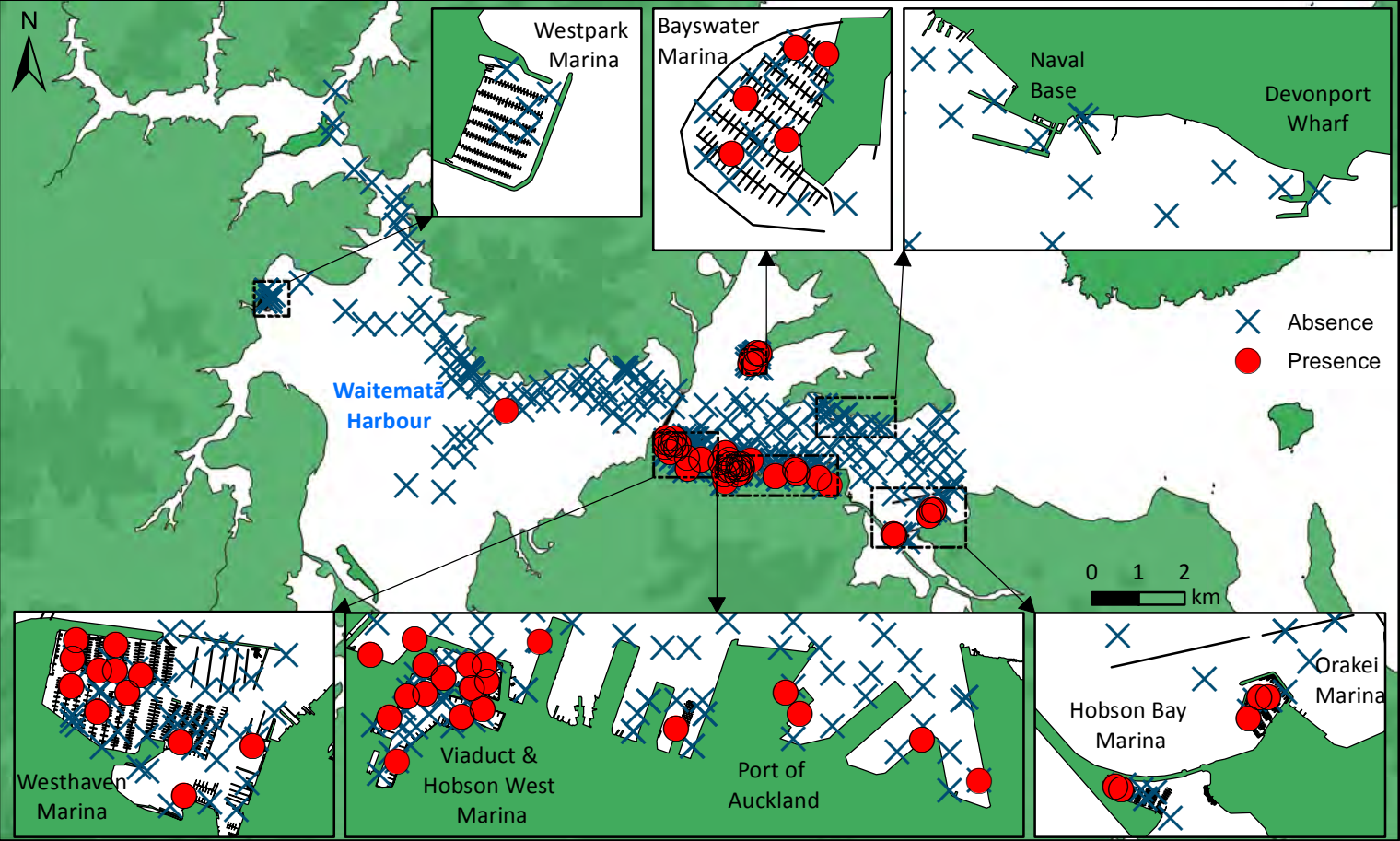
Arcuatula senhousia



Waitematā Harbour

Summer 2017-18

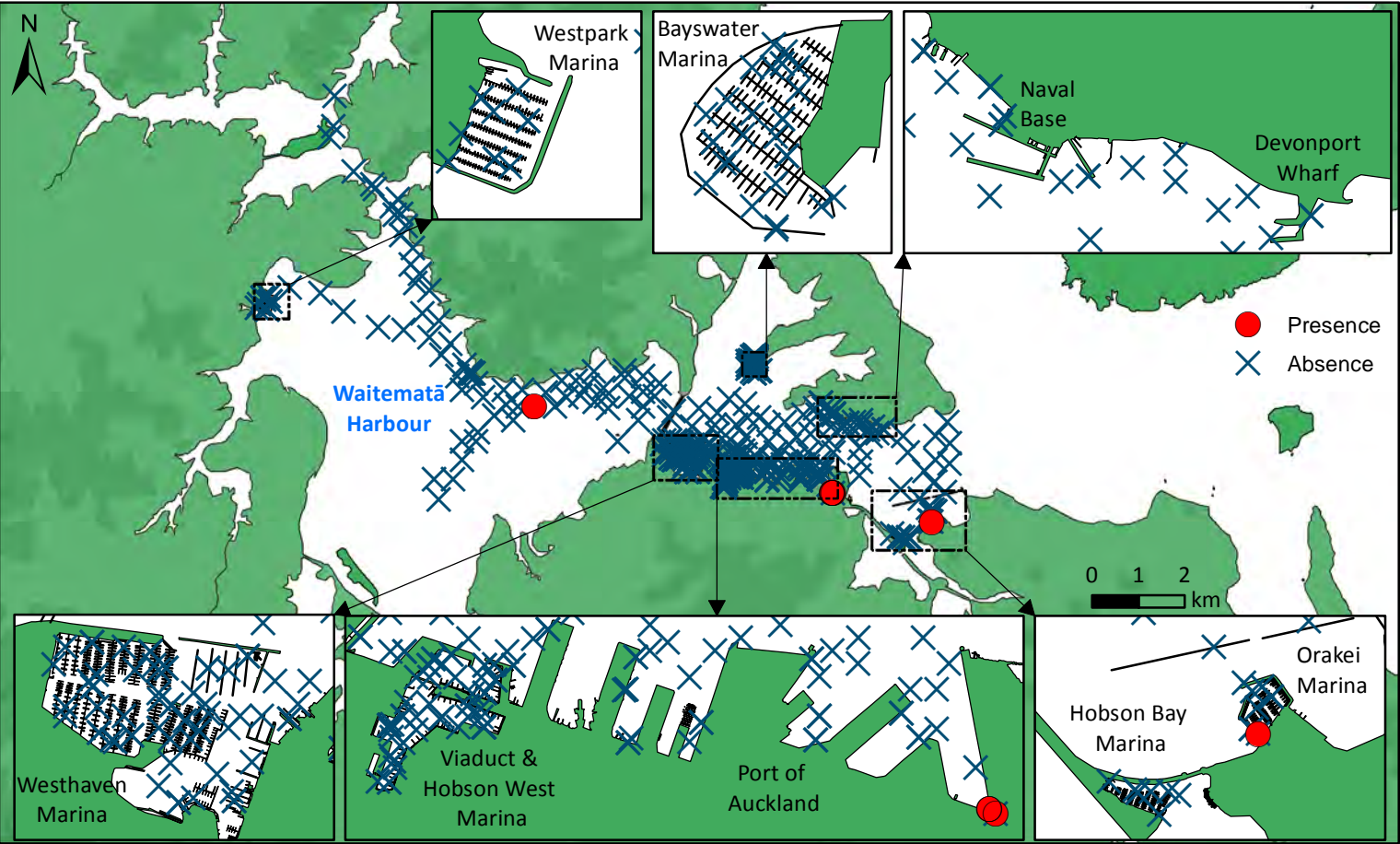
Celloporaria nodulosa



Waitematā Harbour

Winter 2017

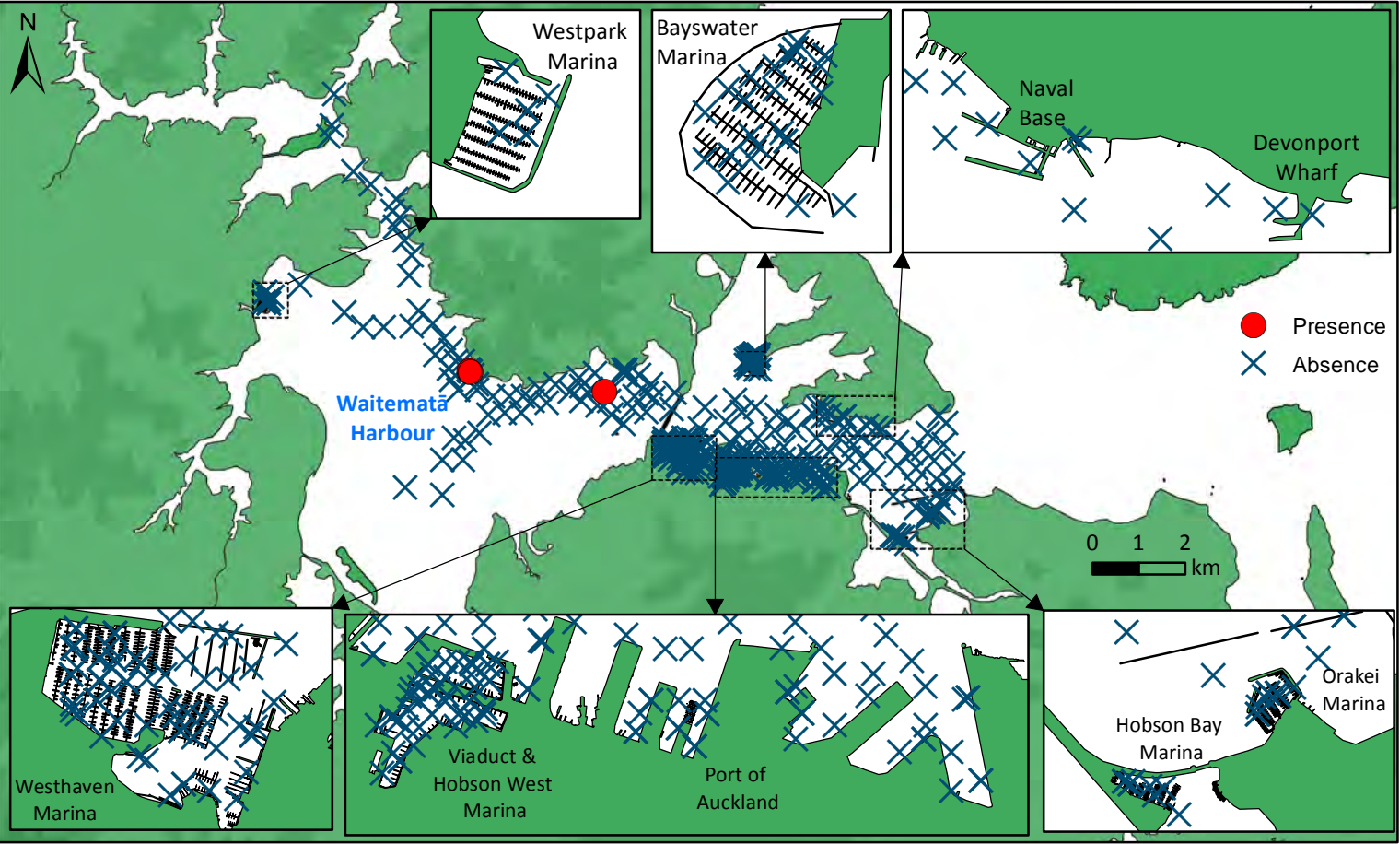
Charydis (Charybdis) japonica



Waitematā Harbour

Summer 2017-18

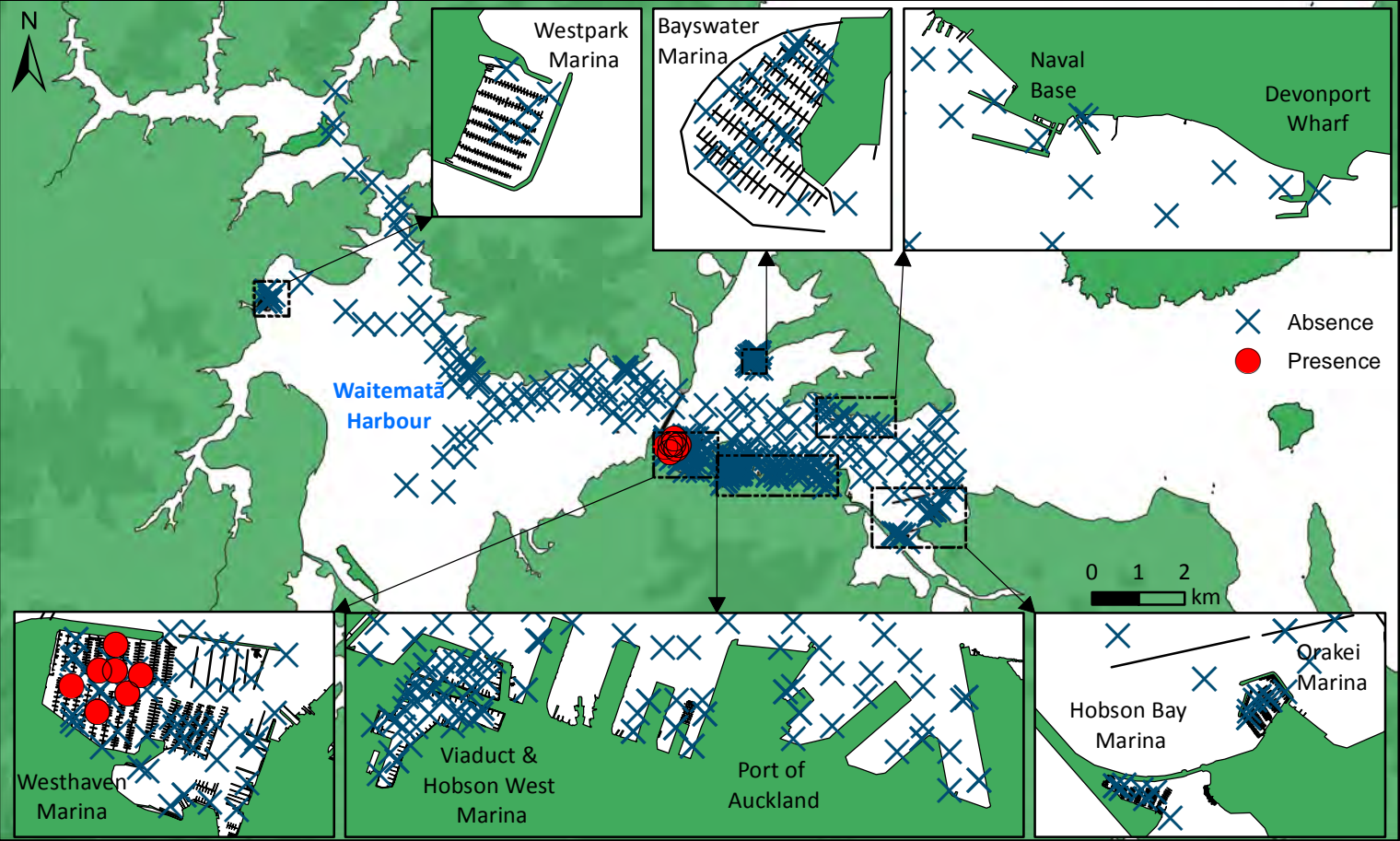
Charydis (Charybdis) japonica



Waitematā Harbour

Summer 2017-18

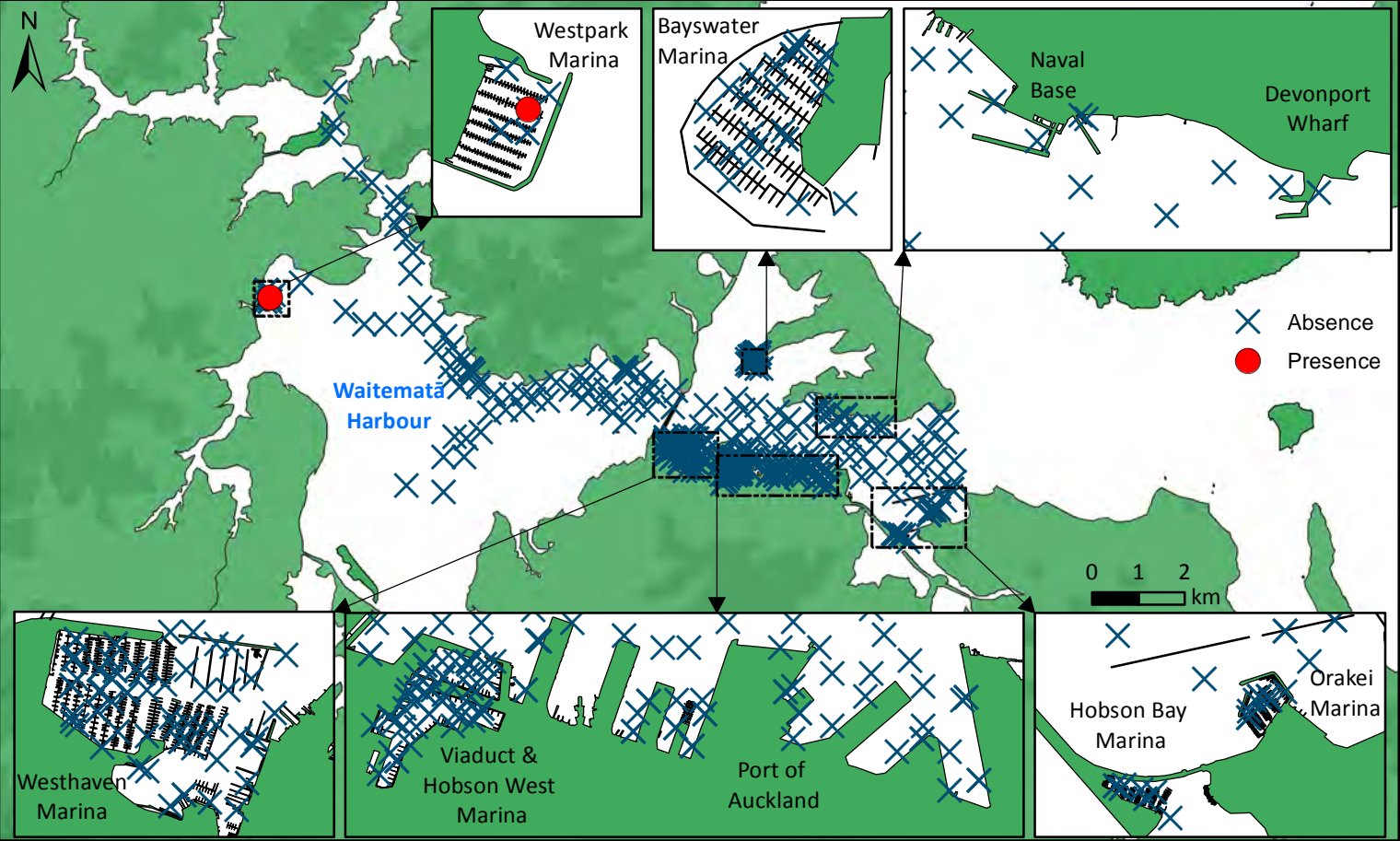
Ciona spp.



Waitematā Harbour

Summer 2017-18

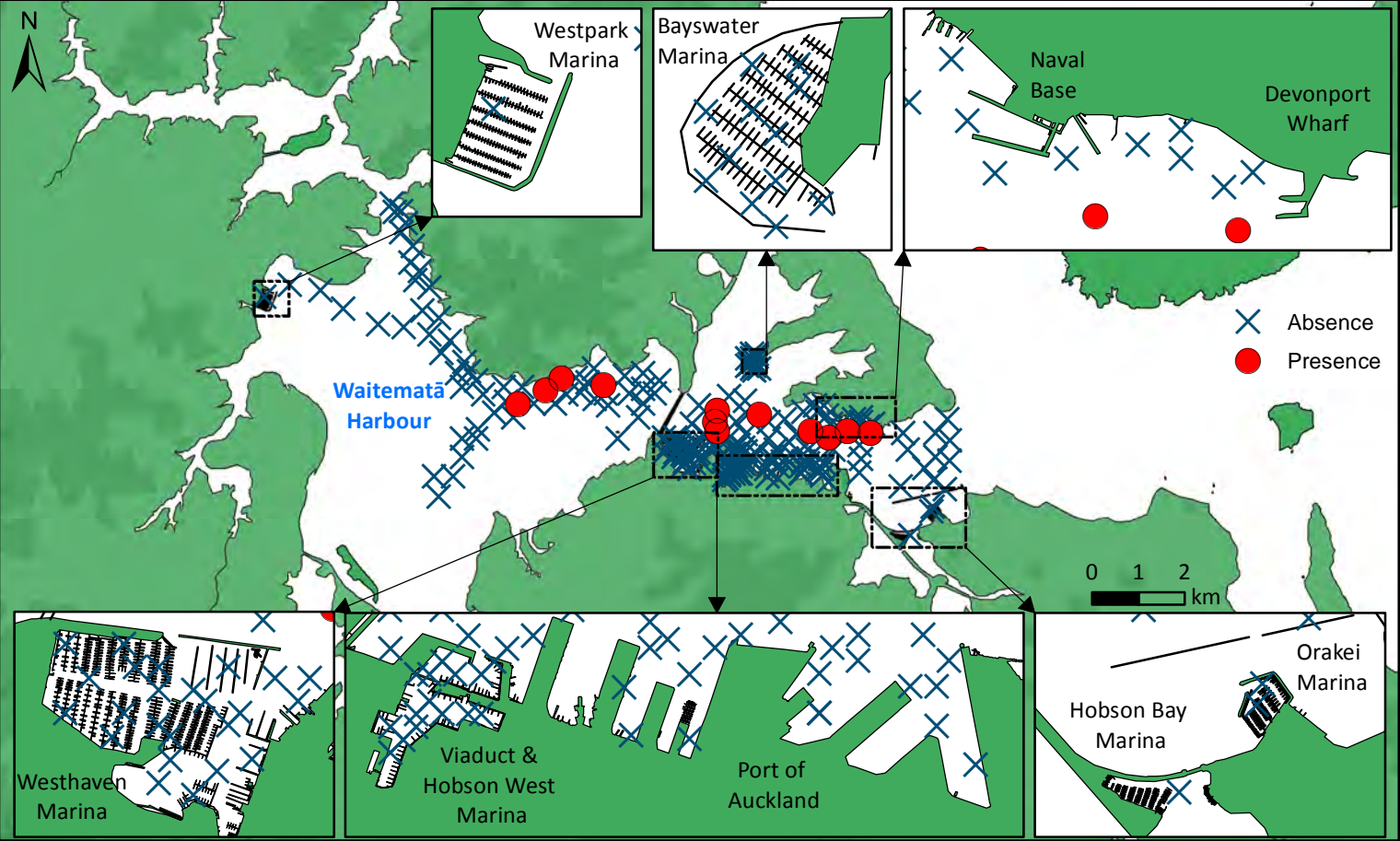
Ectopleura spp.



Waitematā Harbour

Winter 2017

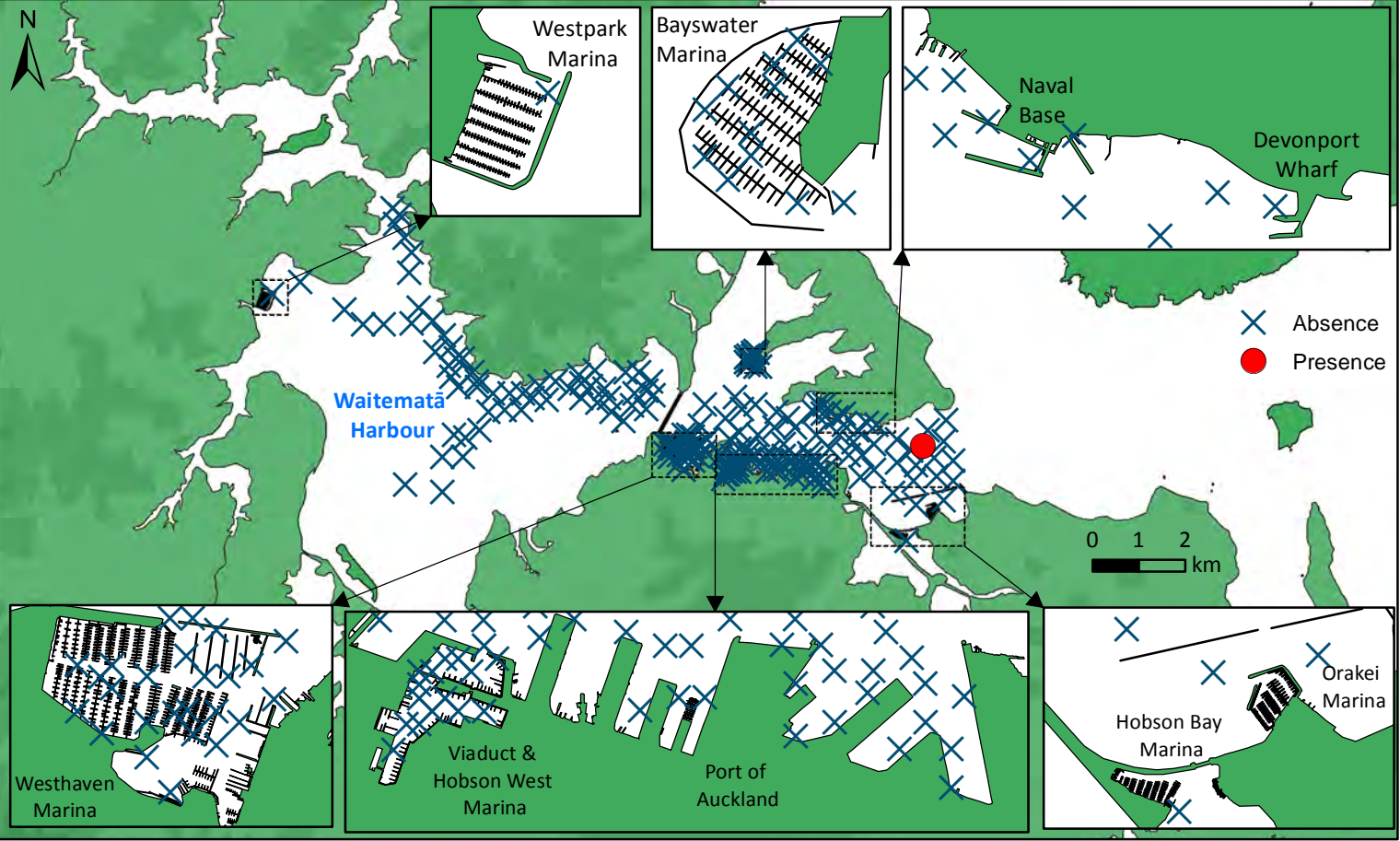
Limaria orientalis



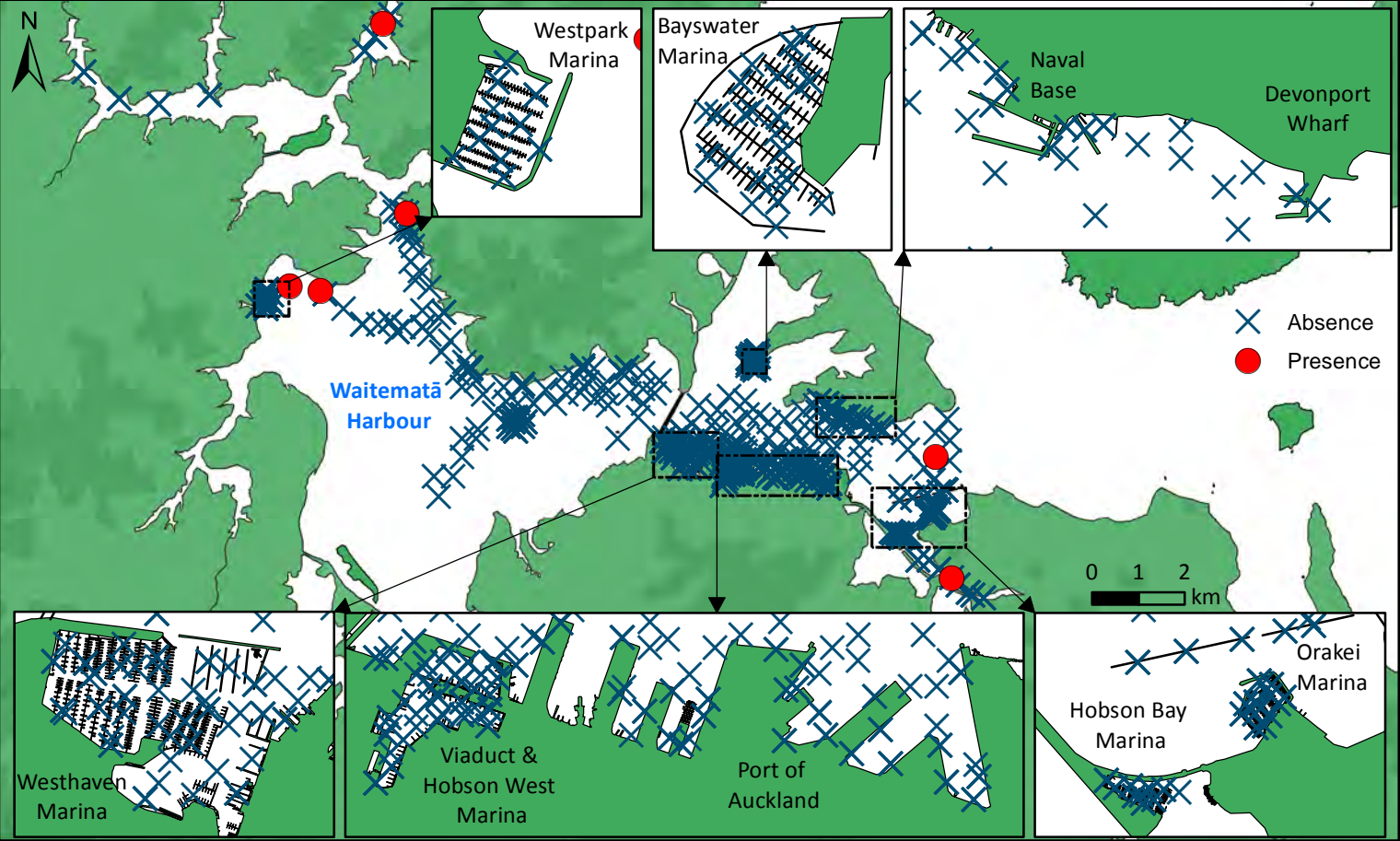
Waitematā Harbour

Summer 2017-18

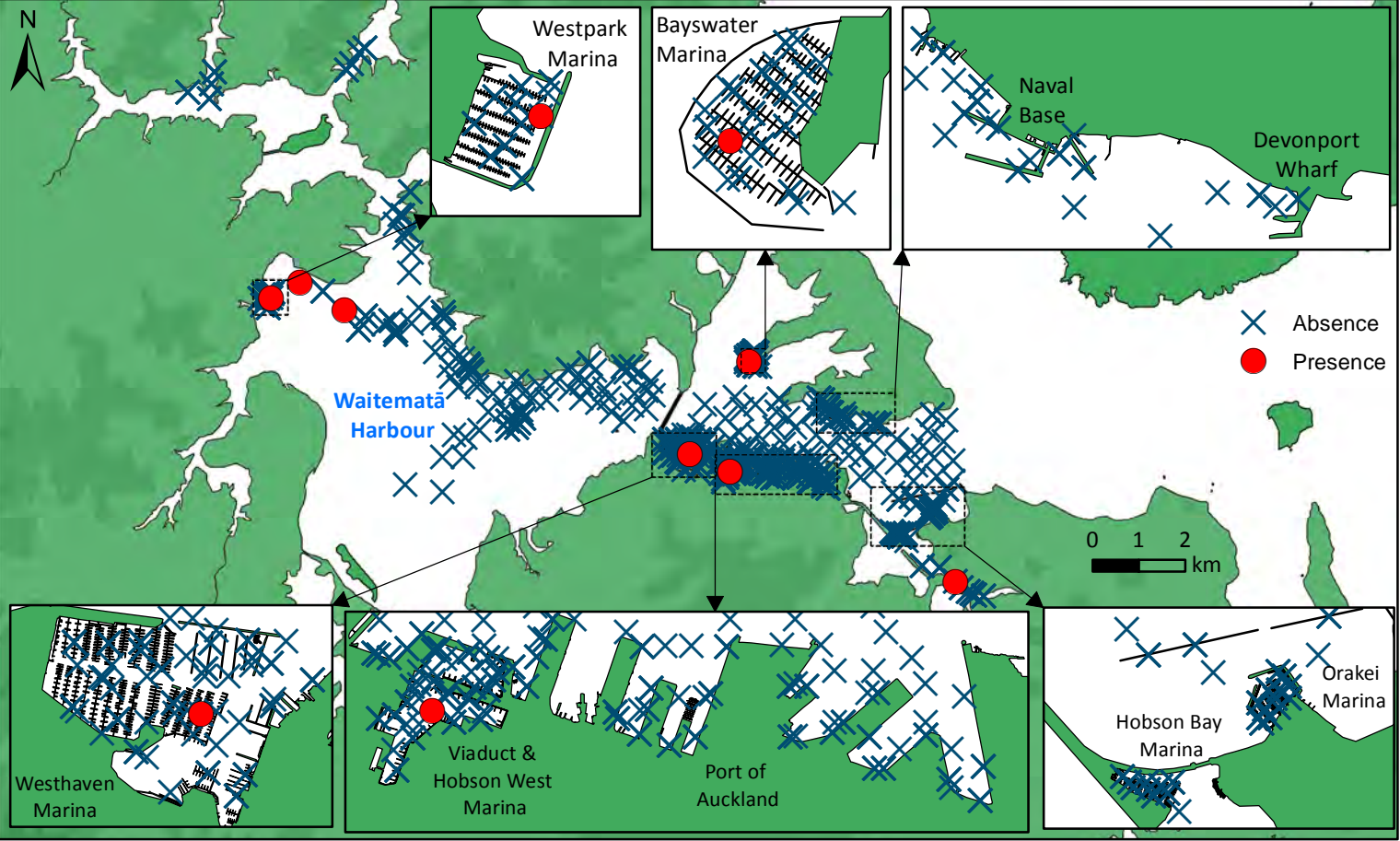
Limaria orientalis



Waitematā Harbour
Winter 2017
Metapenaeus bennettiae



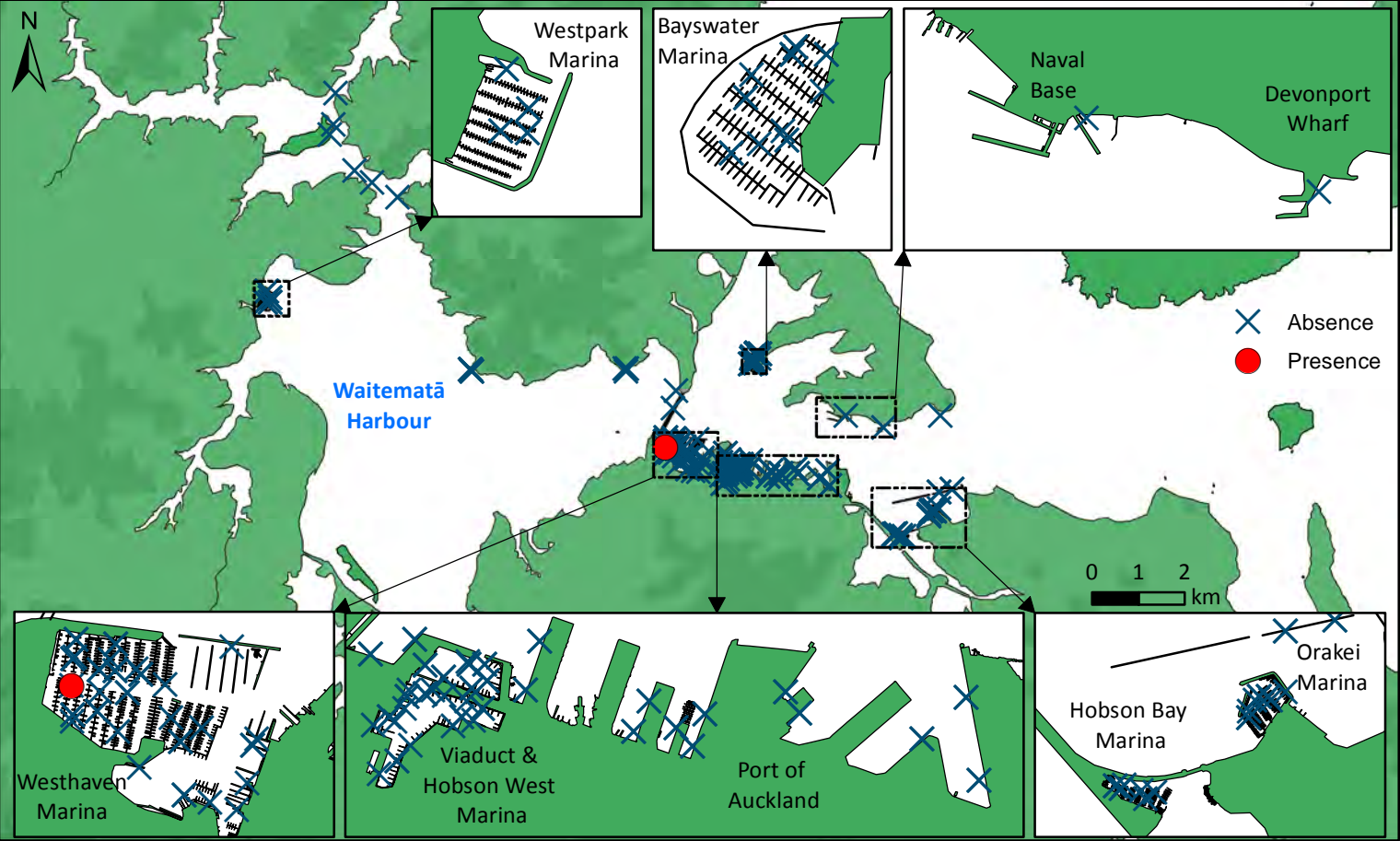
Waitematā Harbour
Summer 2017-18
Metapenaeus bennettiae



Waitematā Harbour

Summer 2017-18

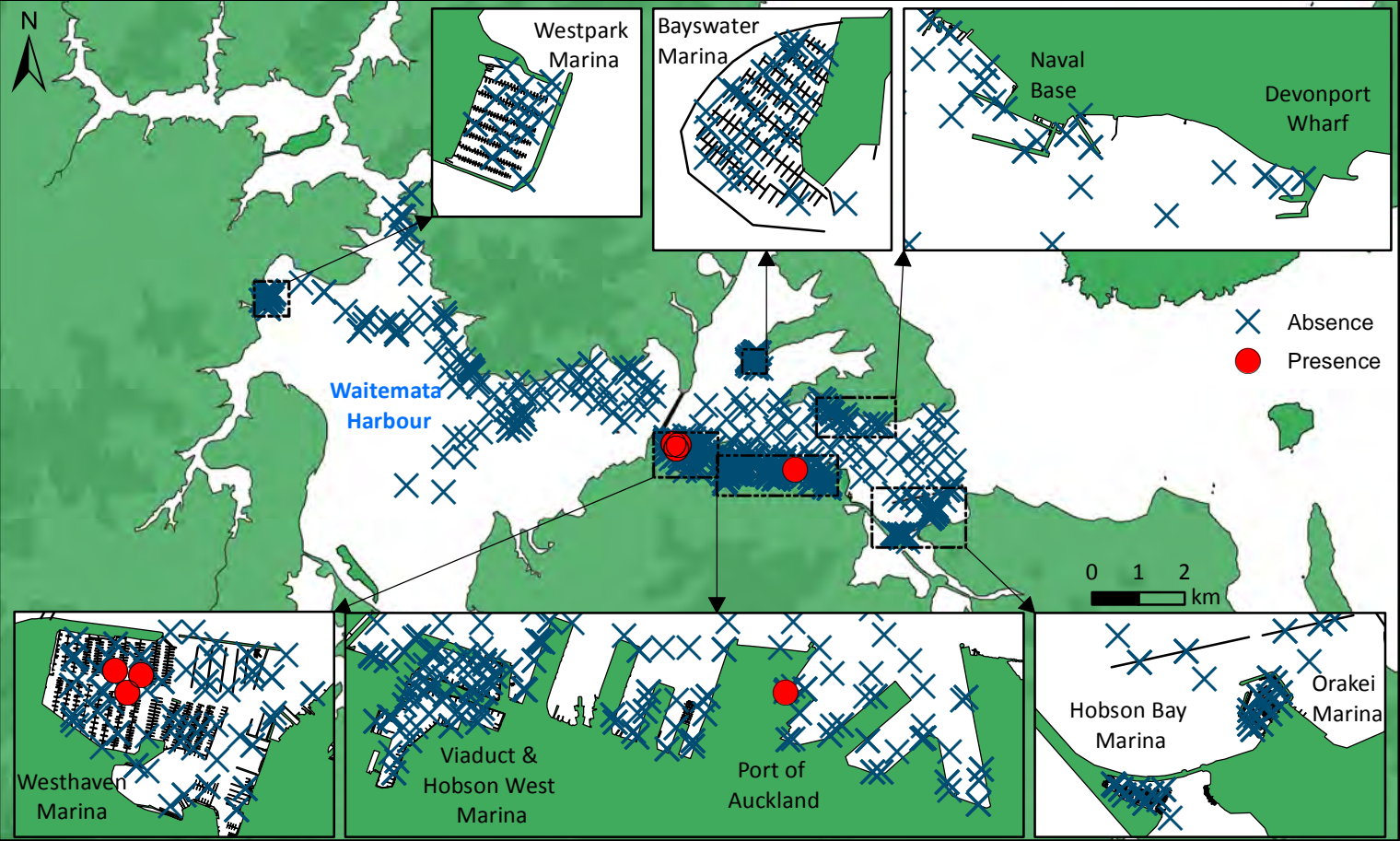
Okenia pellucida



Waitematā Harbour

Summer 2017-18

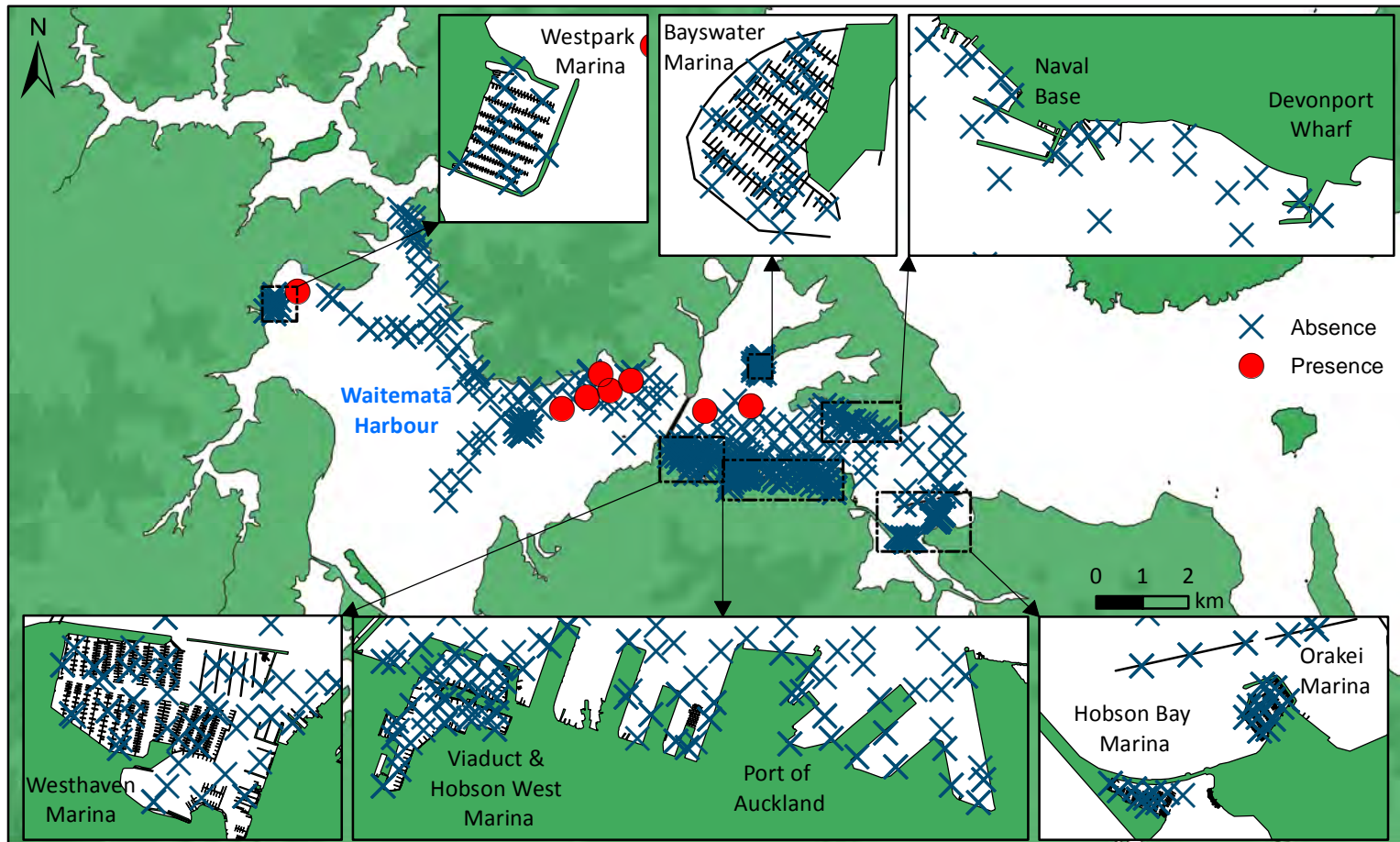
Omobranchus anolius



Waitematā Harbour

Winter 2017

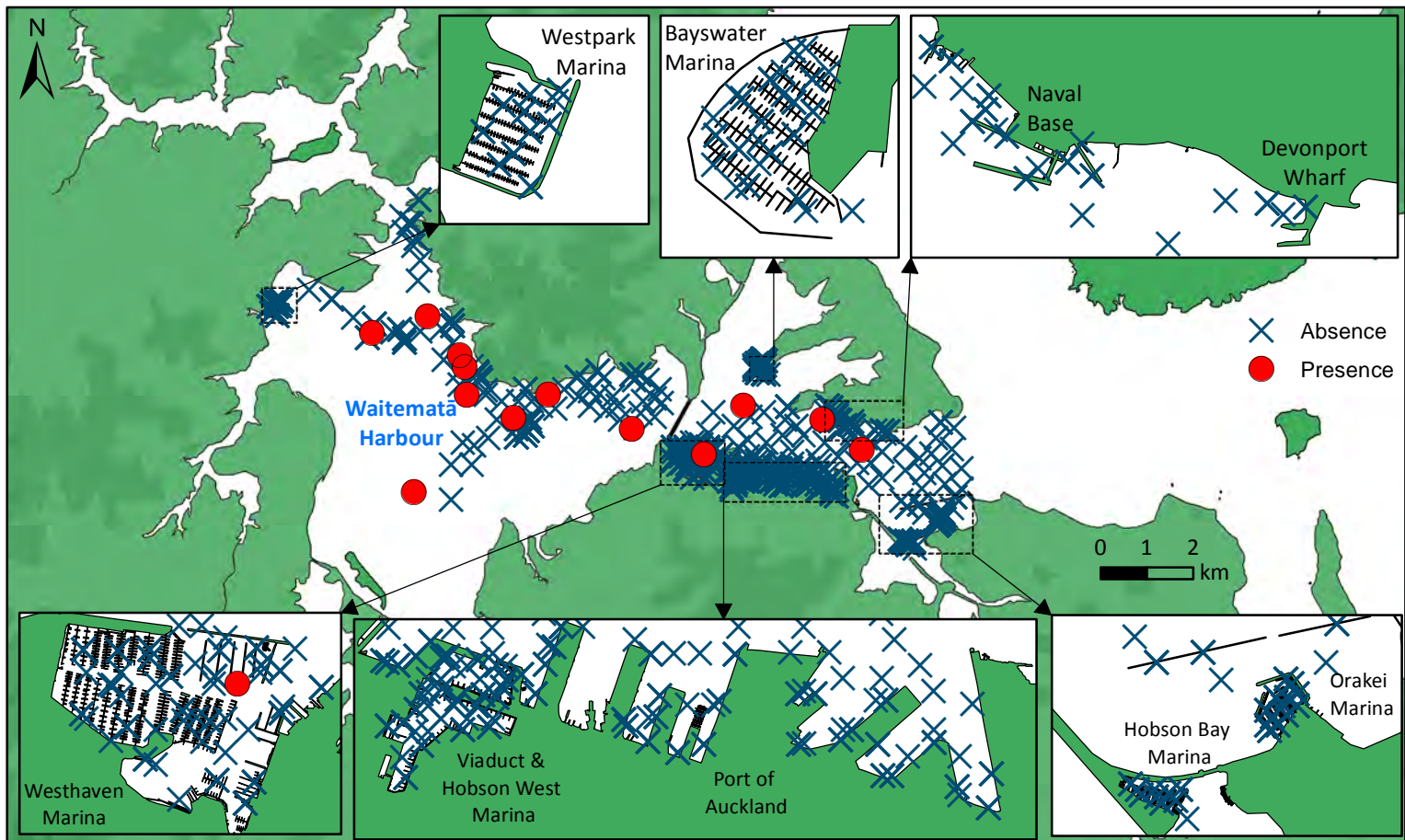
Pyromaia tuberculata



Waitematā Harbour

Summer 2017-18

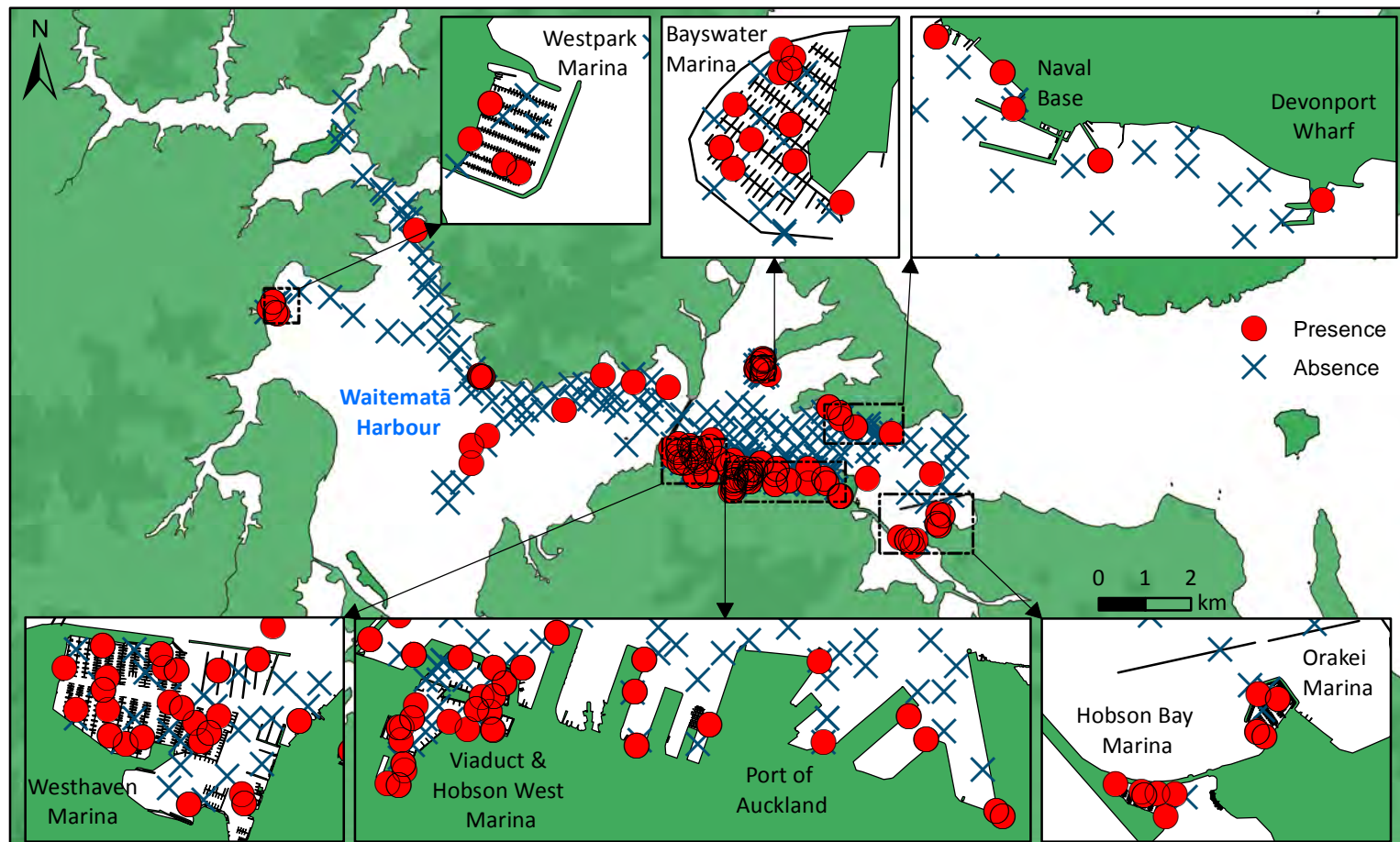
Pyromaia tuberculata



Waitematā Harbour

Winter 2017

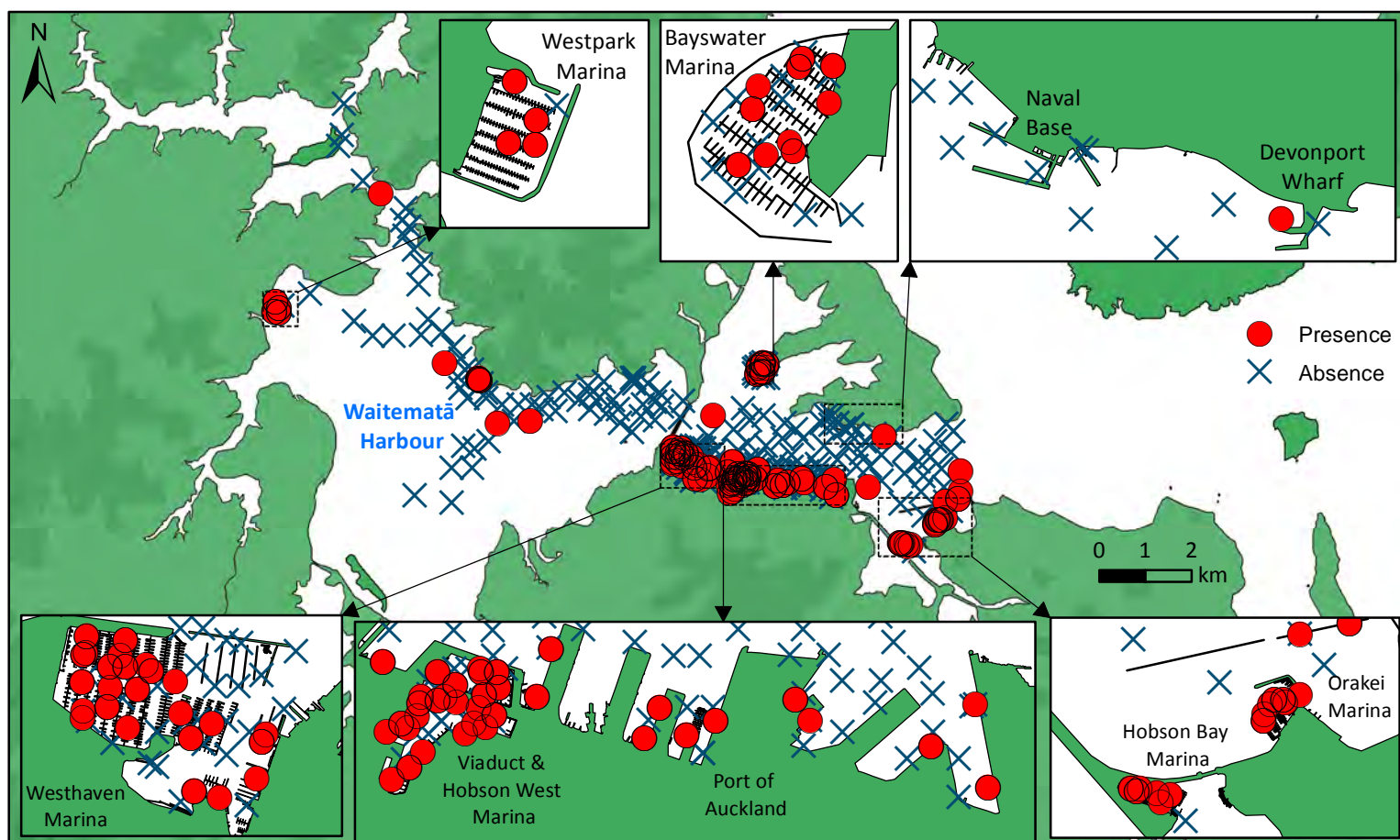
Sabella spallanzanii



Waitematā Harbour

Summer 2017-18

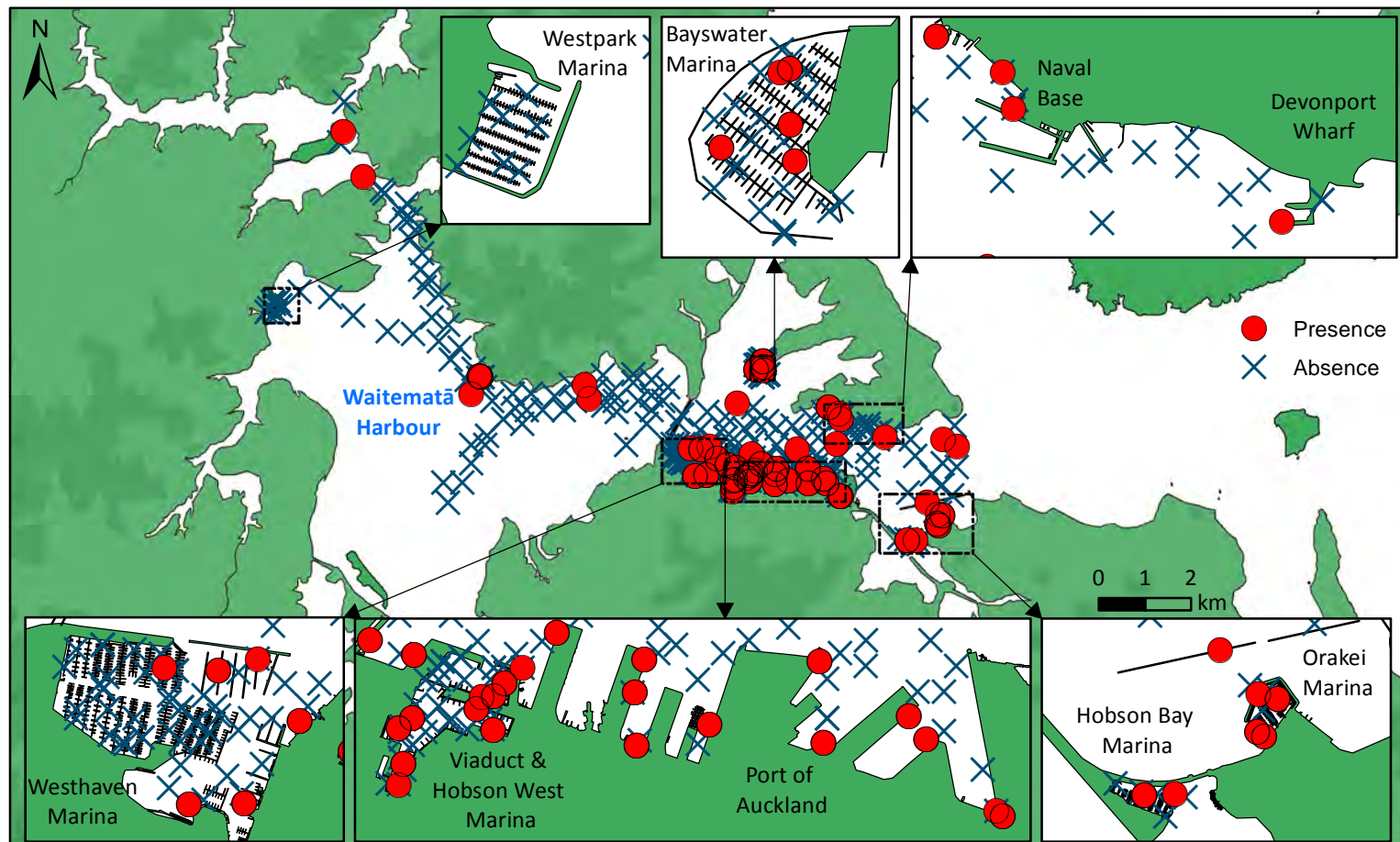
Sabella spallanzanii



Waitematā Harbour

Winter 2017

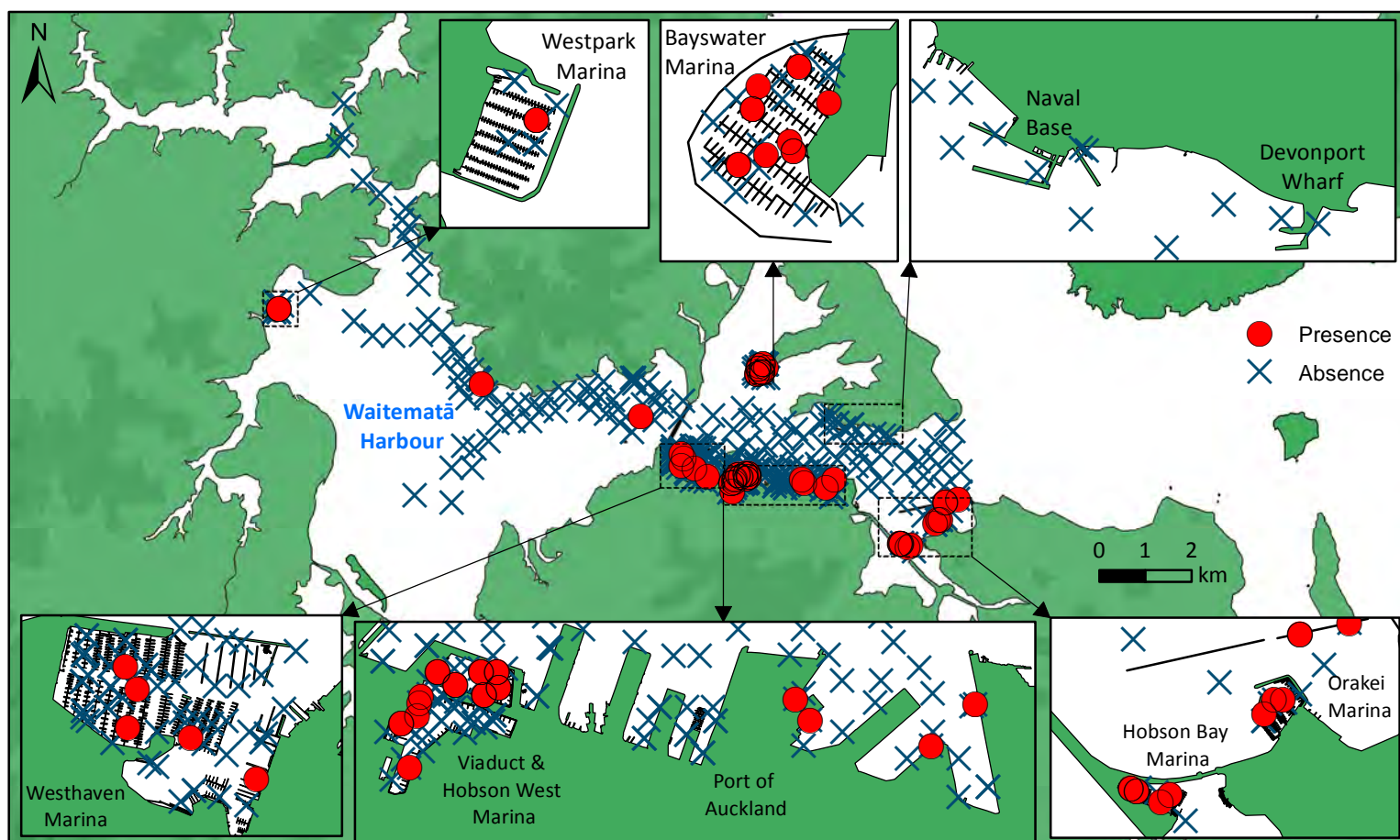
Styela clava



Waitematā Harbour

Summer 2017-18

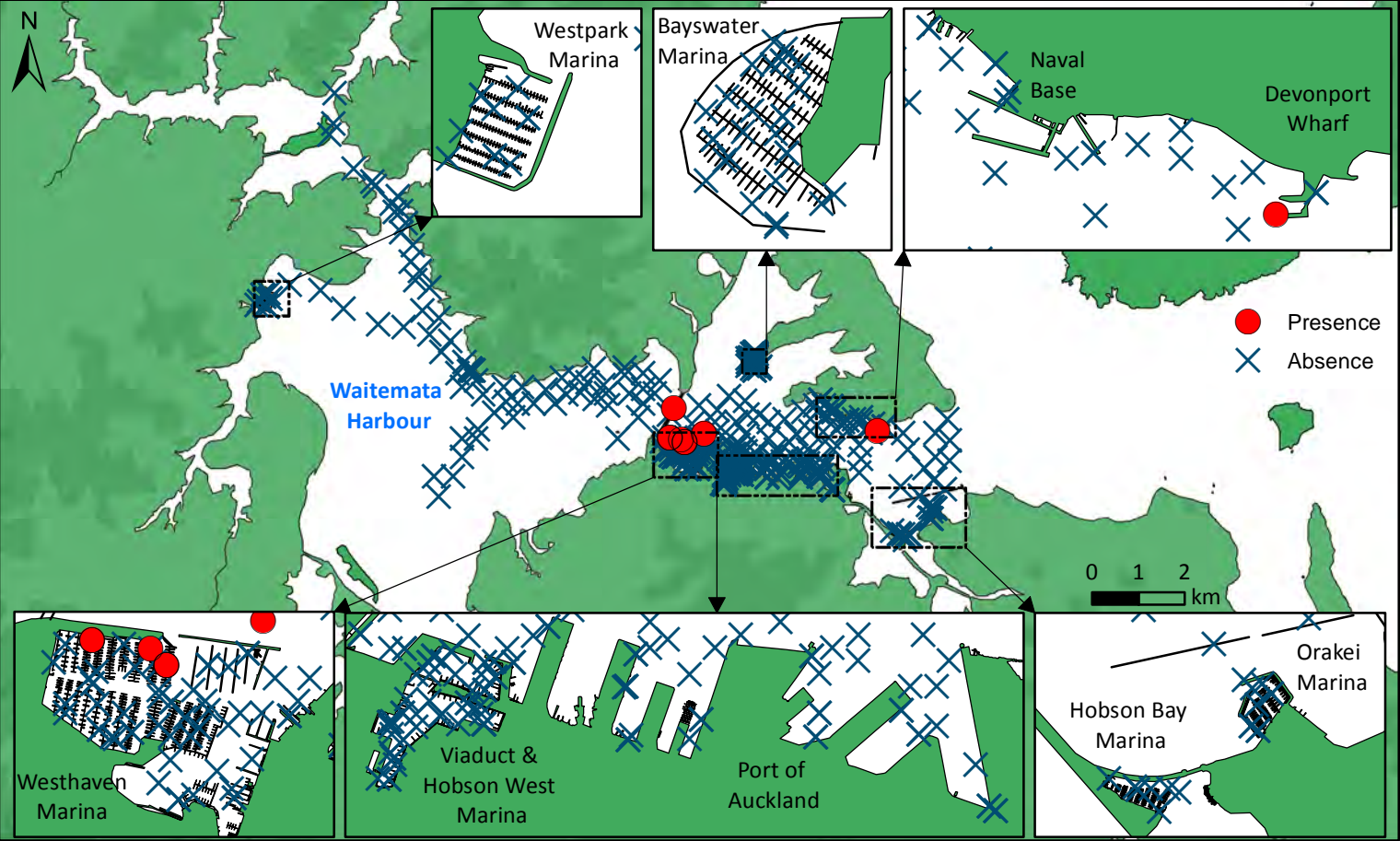
Styela clava



Waitematā Harbour

Winter 2017

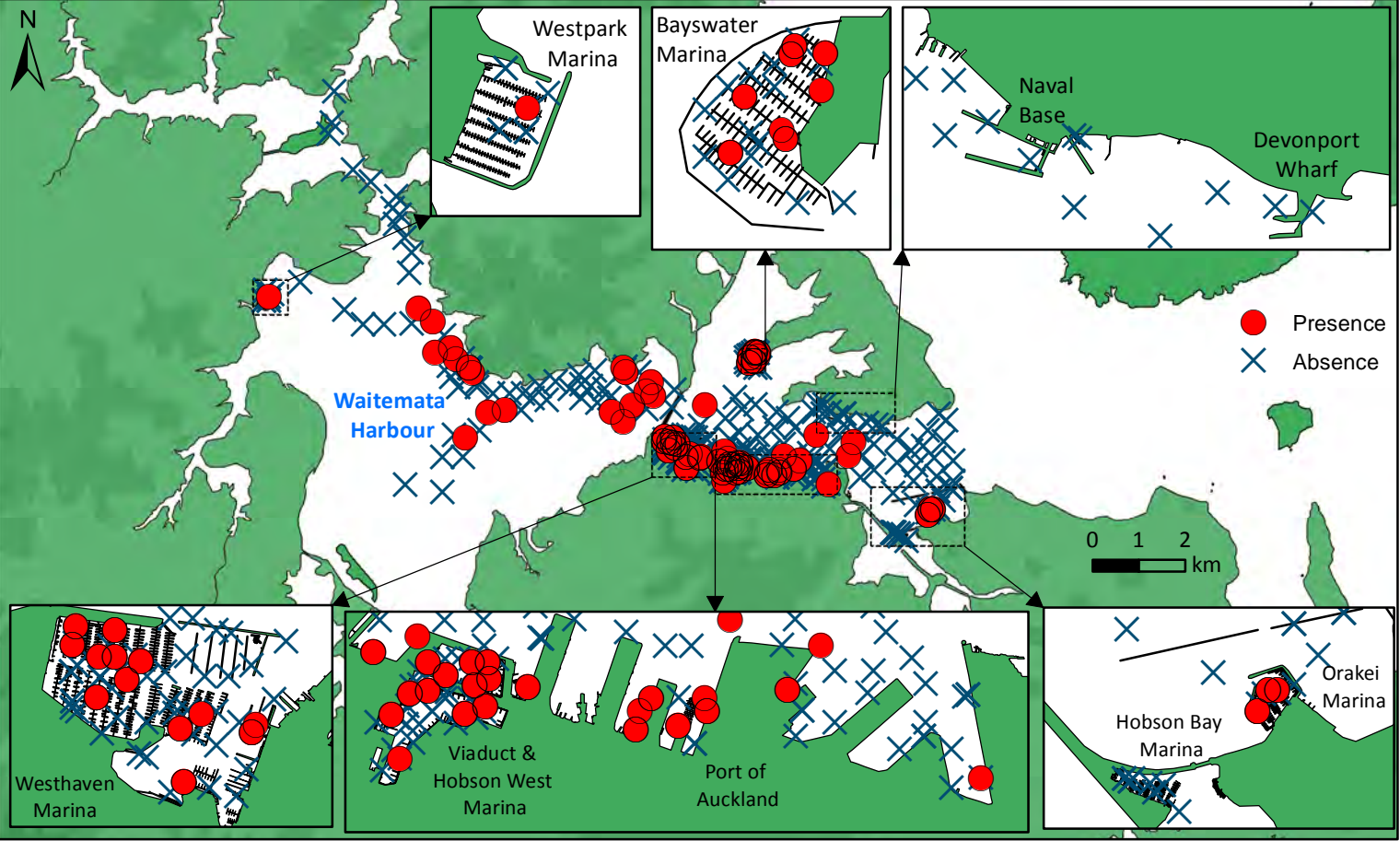
Symplegma brakenhielmi



Waitematā Harbour

Summer 2017-18

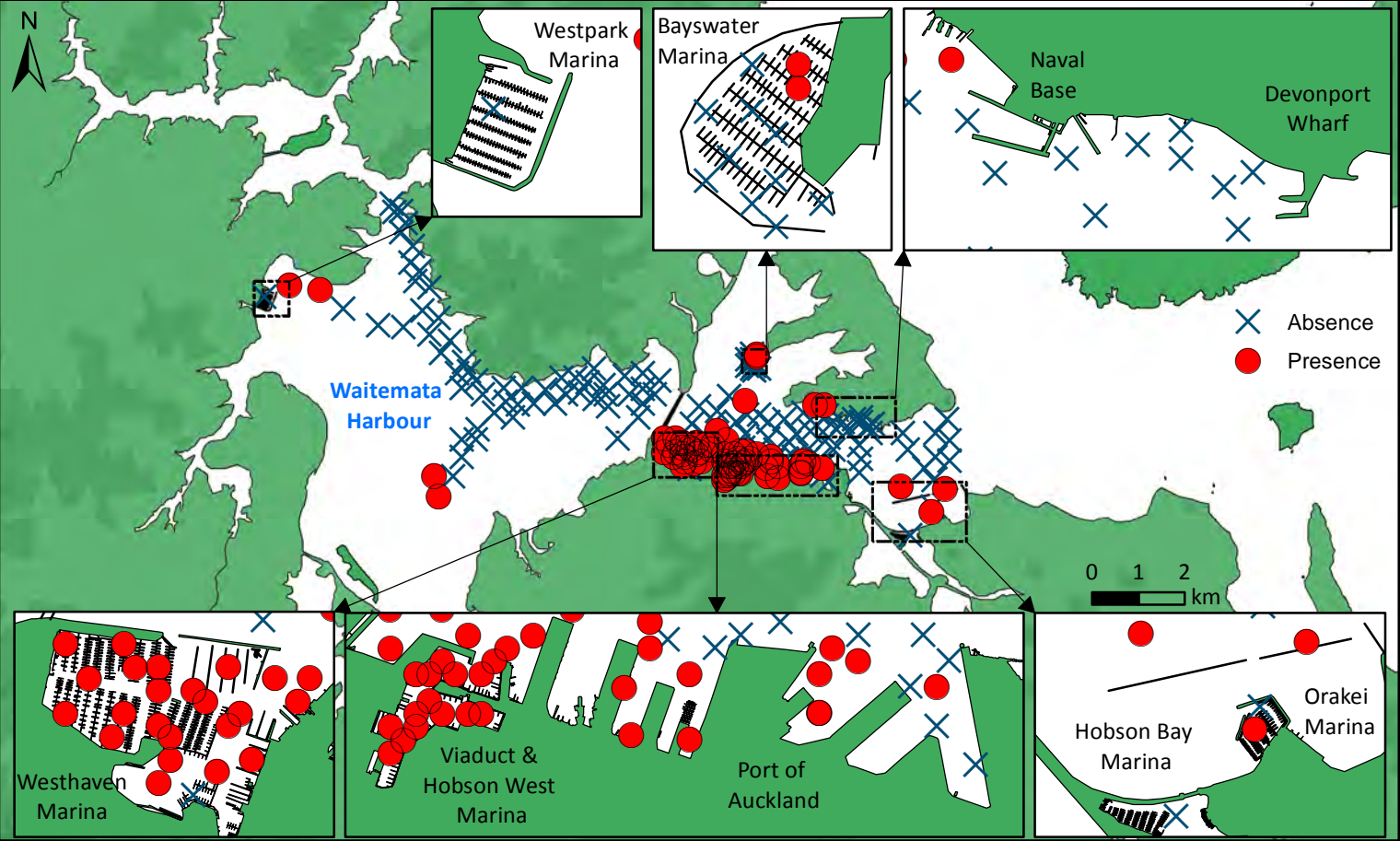
Symplegma brakenhielmi



Waitematā Harbour

Winter 2017

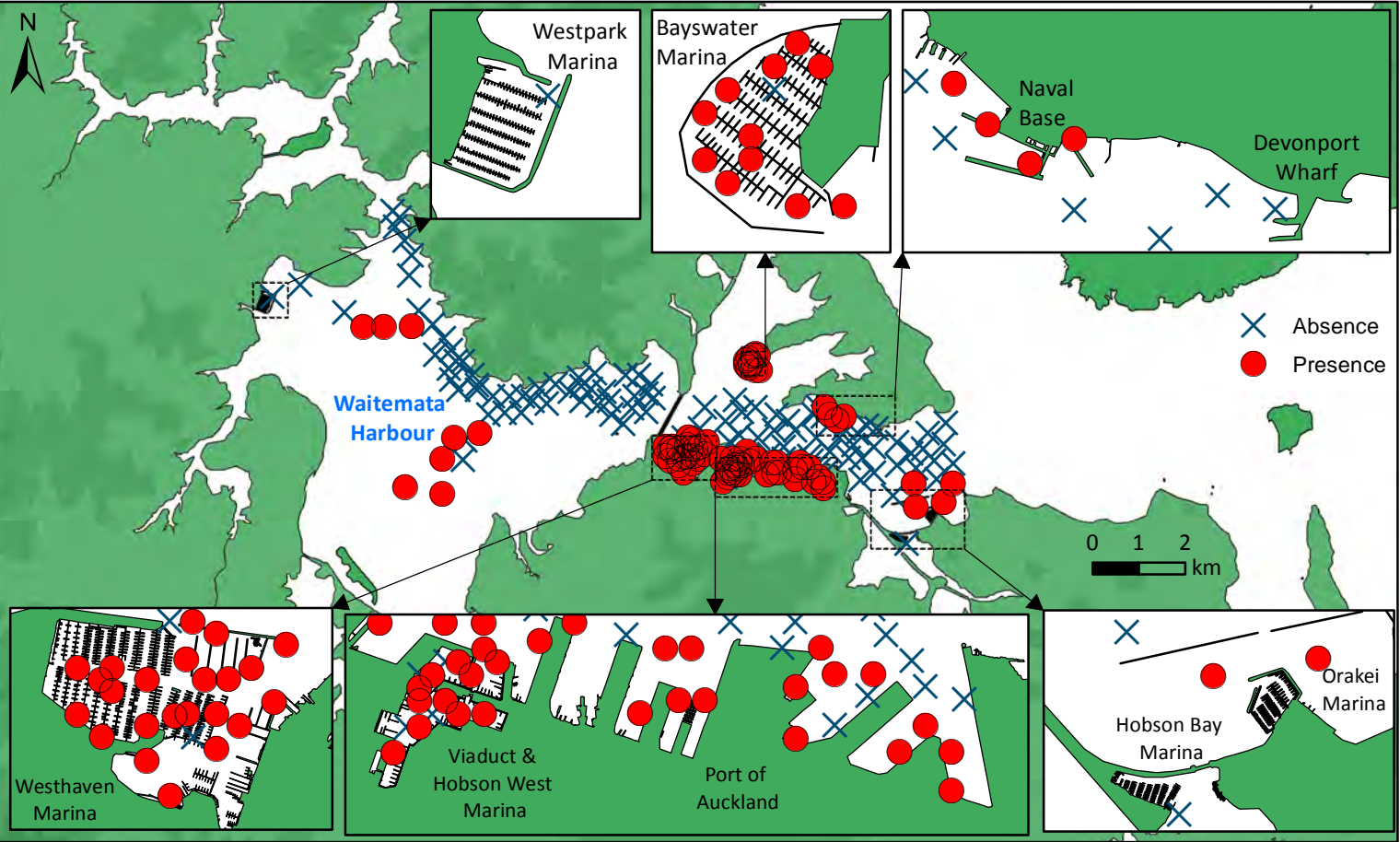
Theora lubrica



Waitematā Harbour

Summer 2017-18

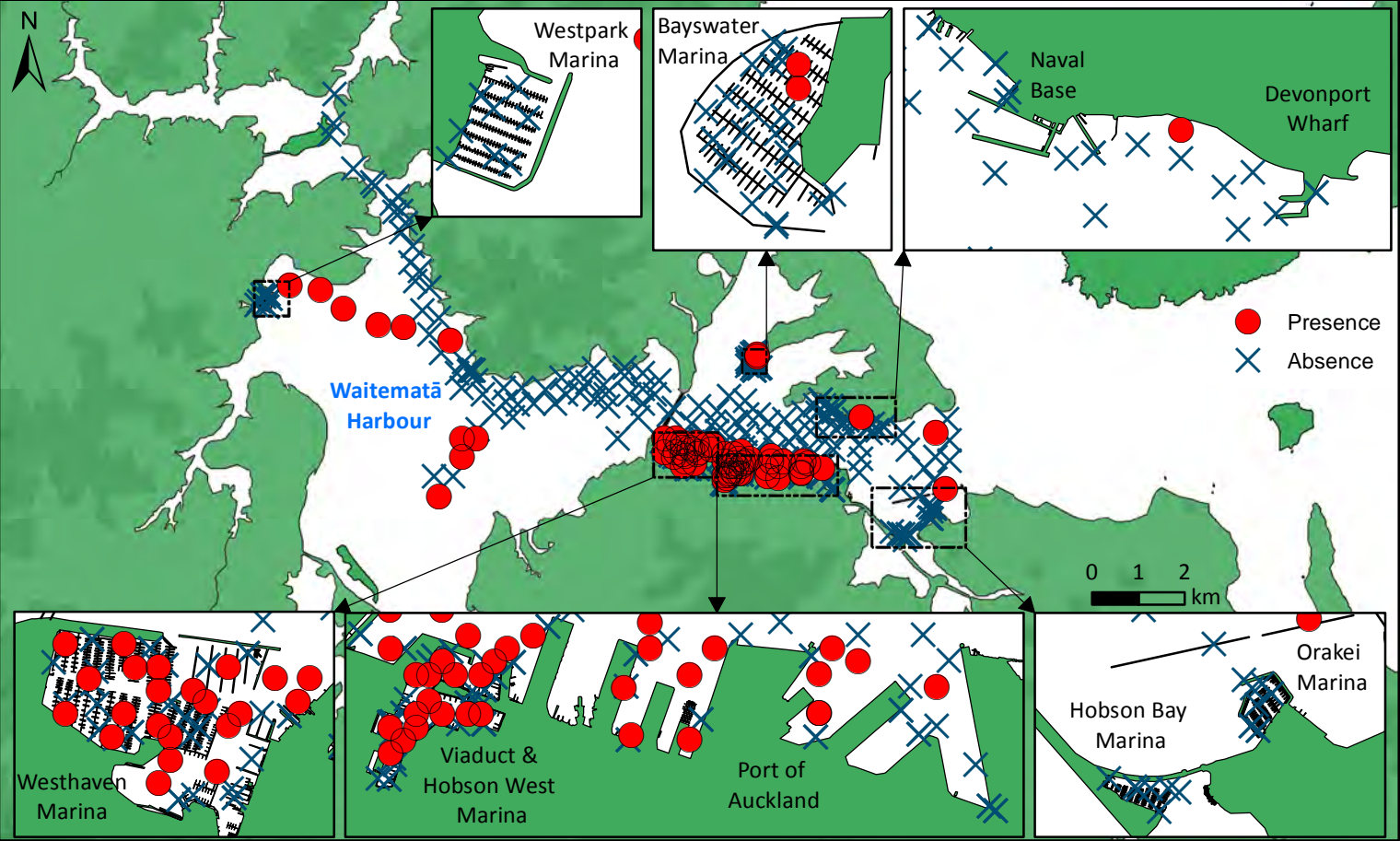
Theora lubrica



Waitematā Harbour

Winter 2017

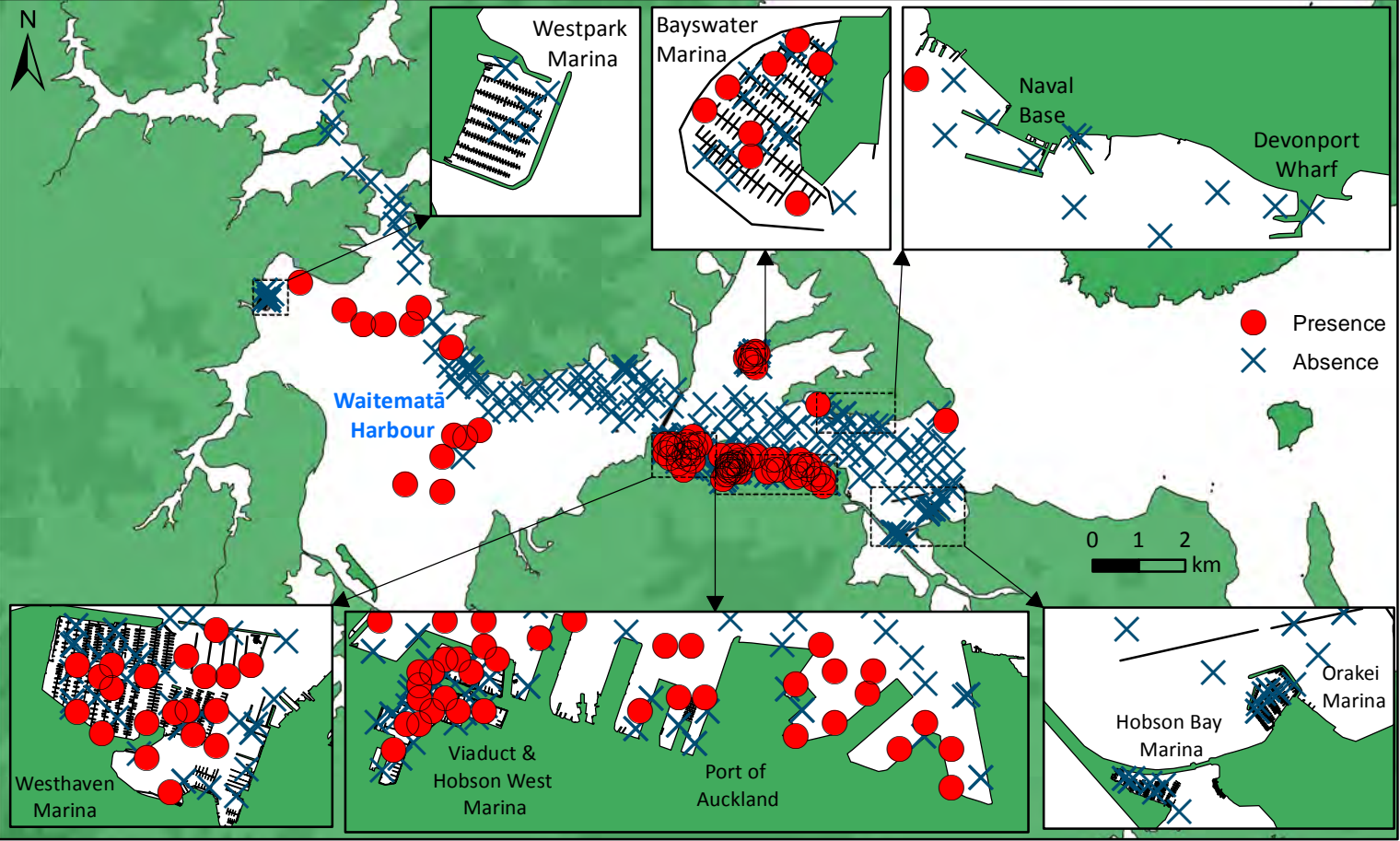
Tritia burchardi



Waitematā Harbour

Summer 2017-18

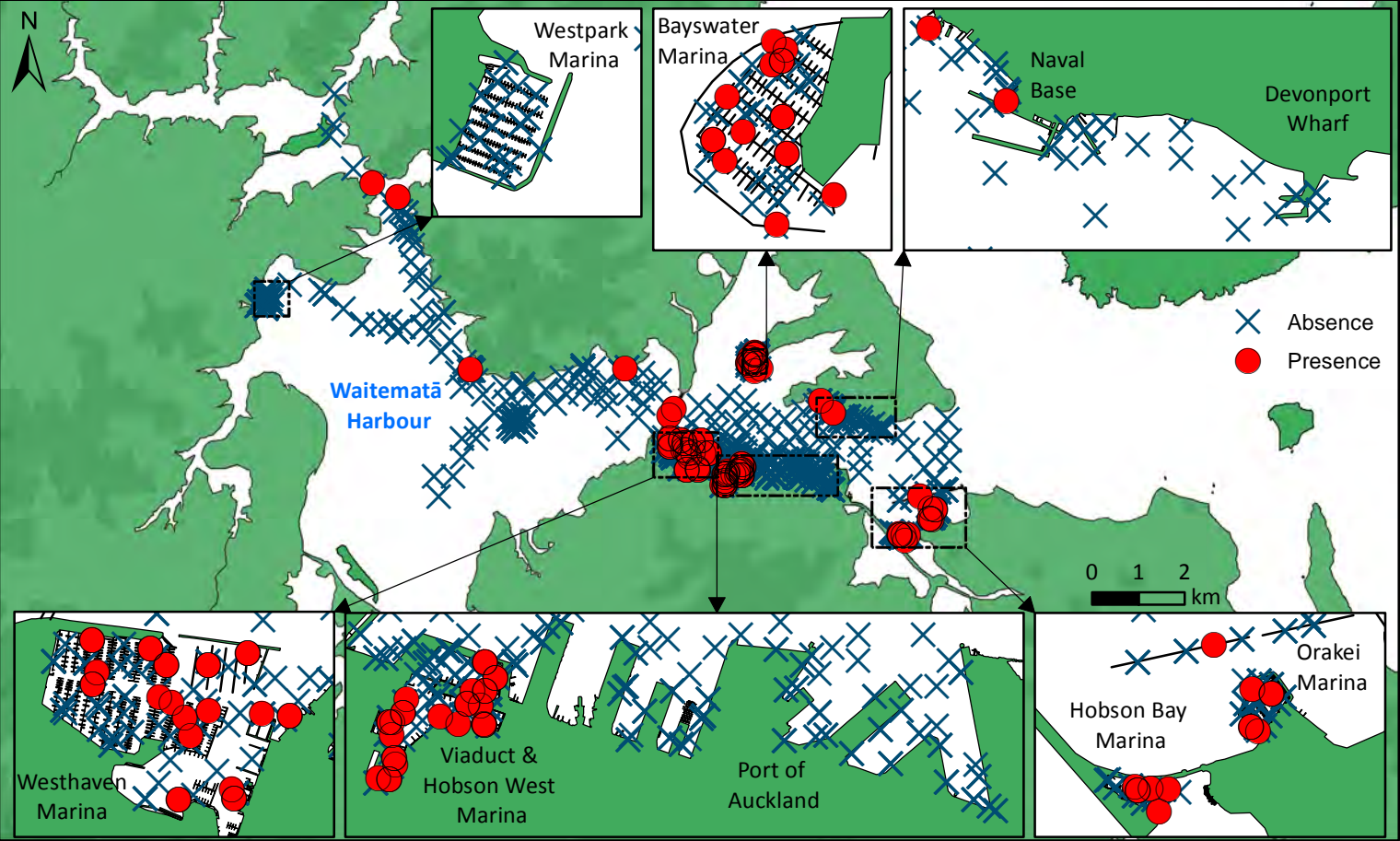
Tritia burchardi



Waitematā Harbour

Winter 2017

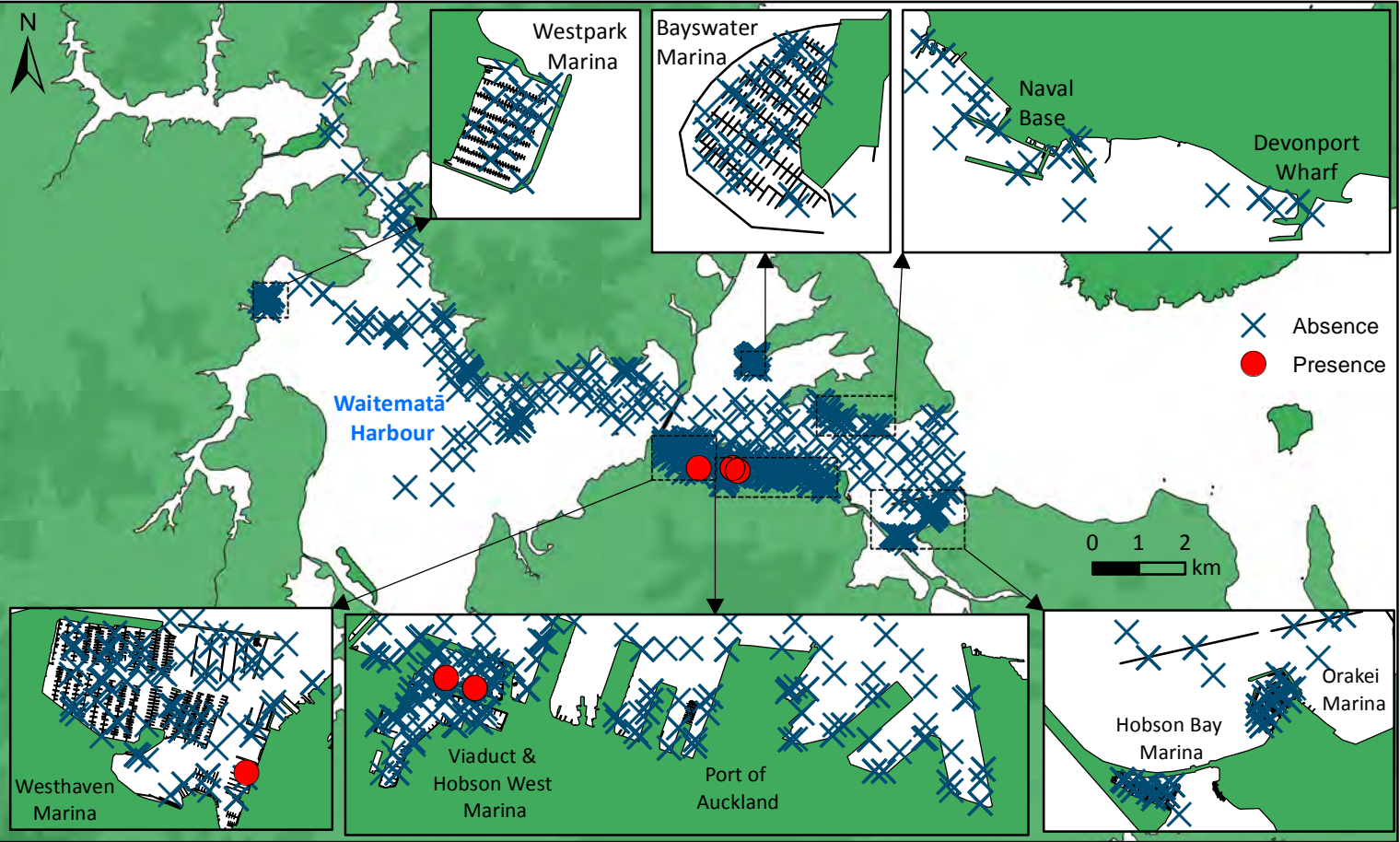
Undaria pinnatifida



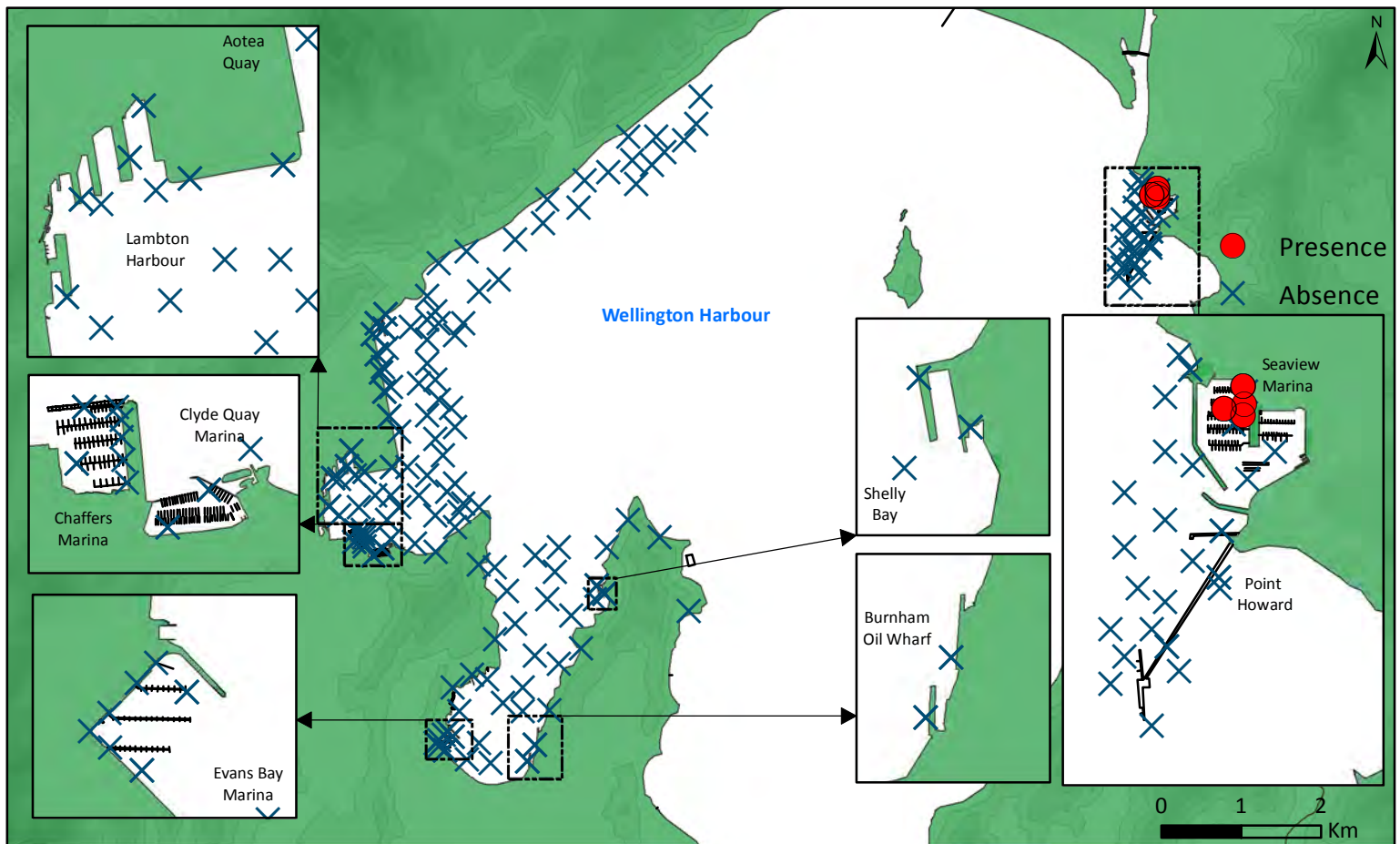
Waitematā Harbour

Summer 2017-18

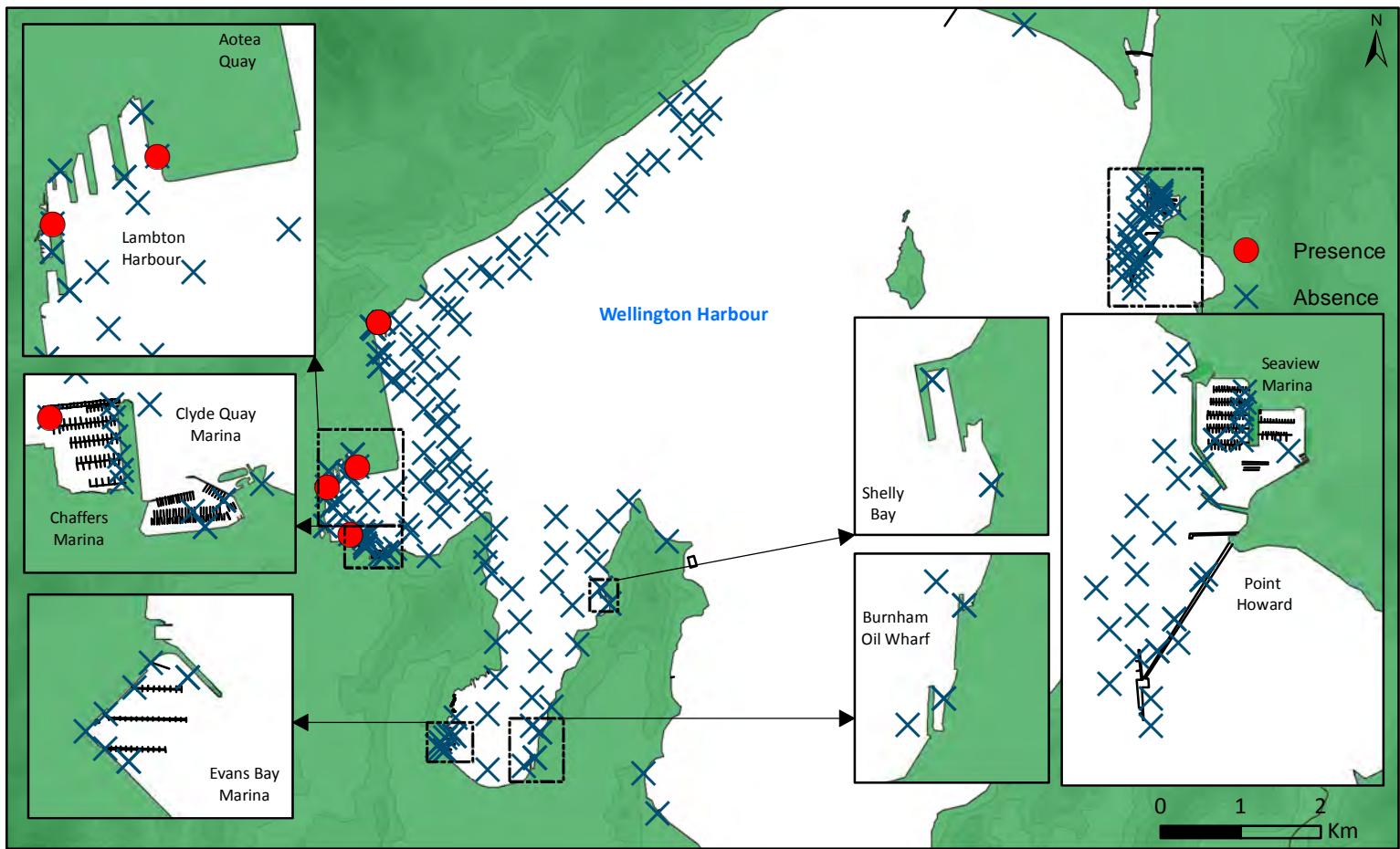
Undaria pinnatifida



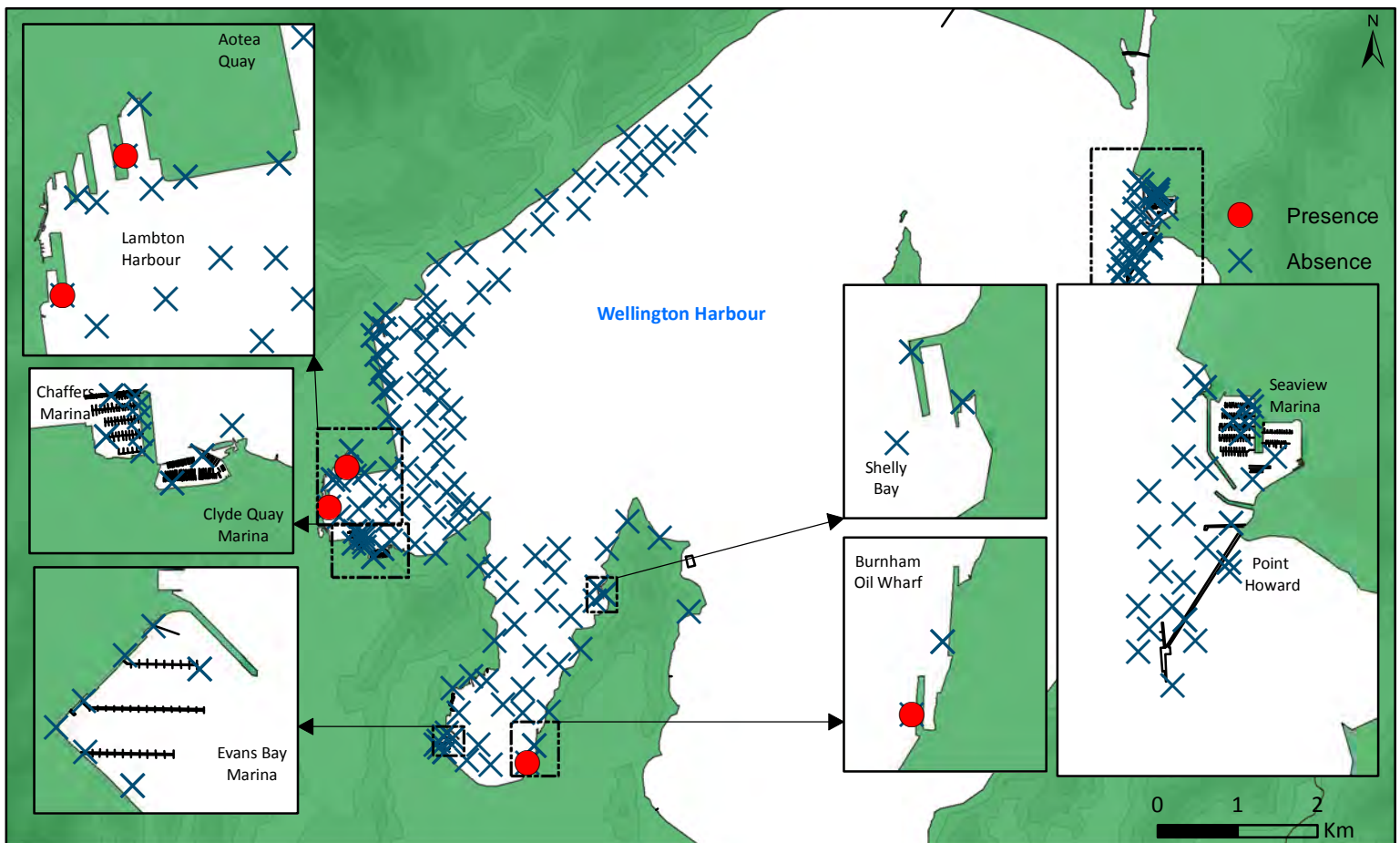
Wellington Harbour
Summer 2017-18
Clavelina lepadiformis



Wellington Harbour
Winter 2017
Didemnum vexillum



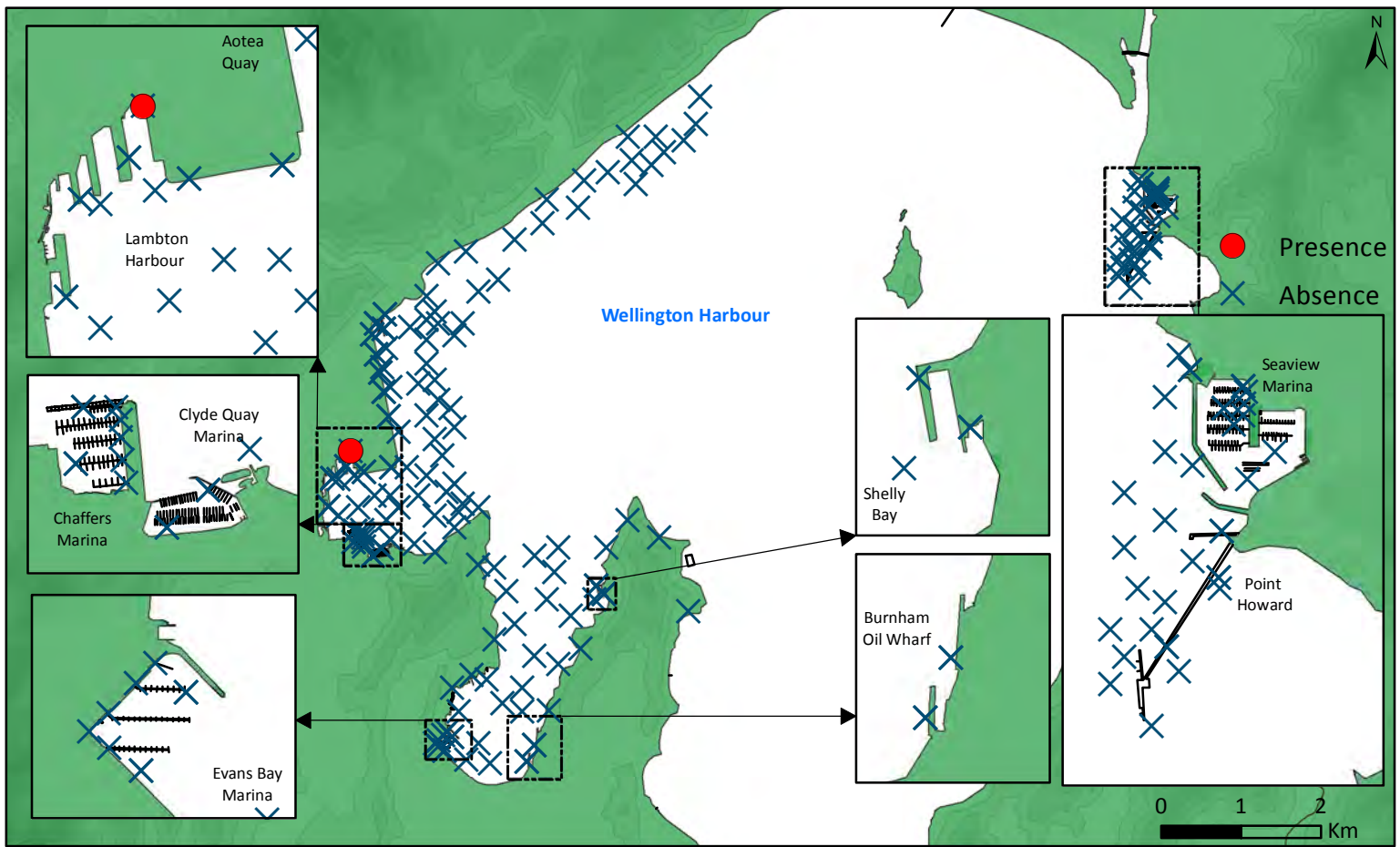
Wellington Harbour
Summer 2017-18
Didemnum vexillum



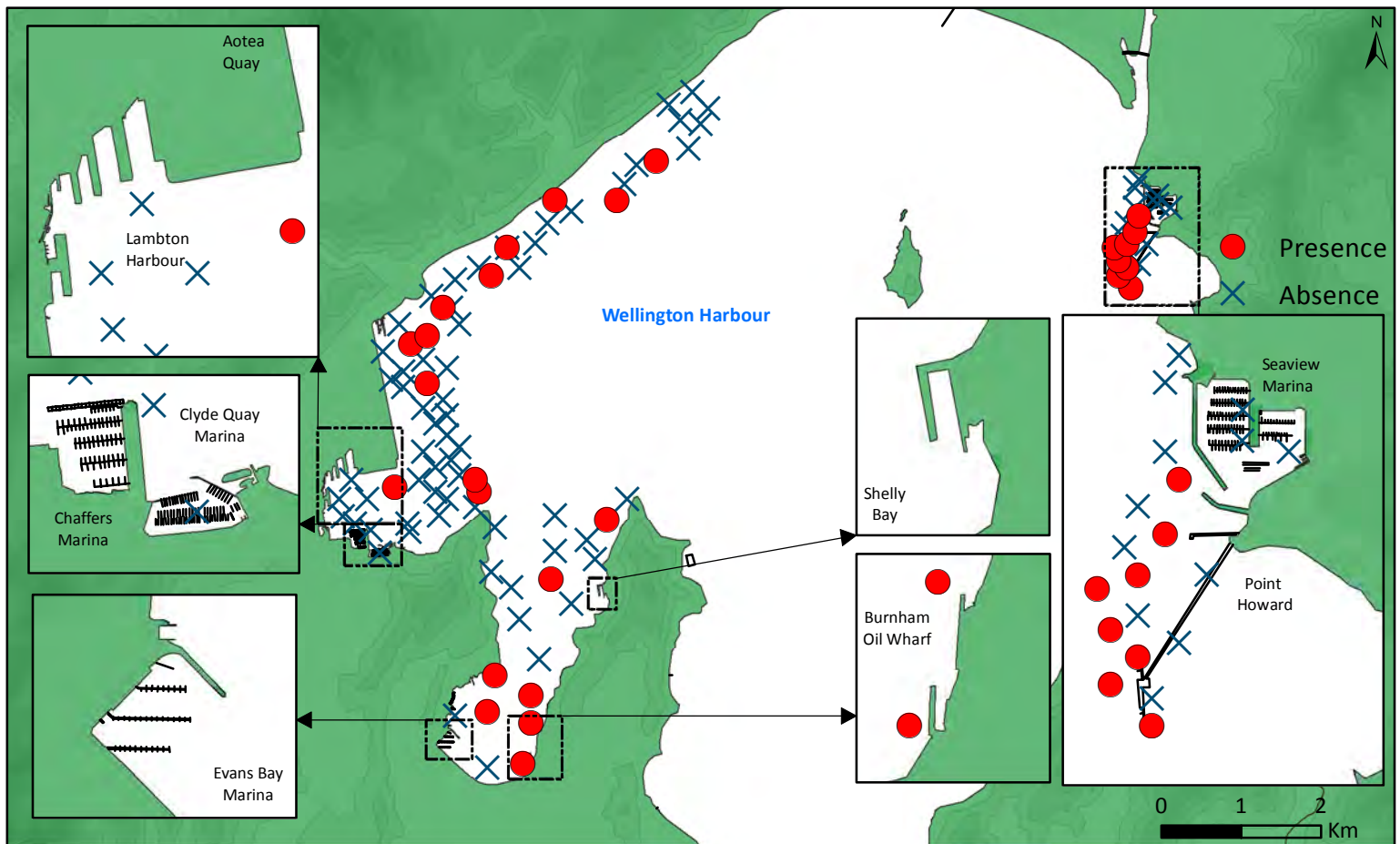
Wellington Harbour

Summer 2017-18

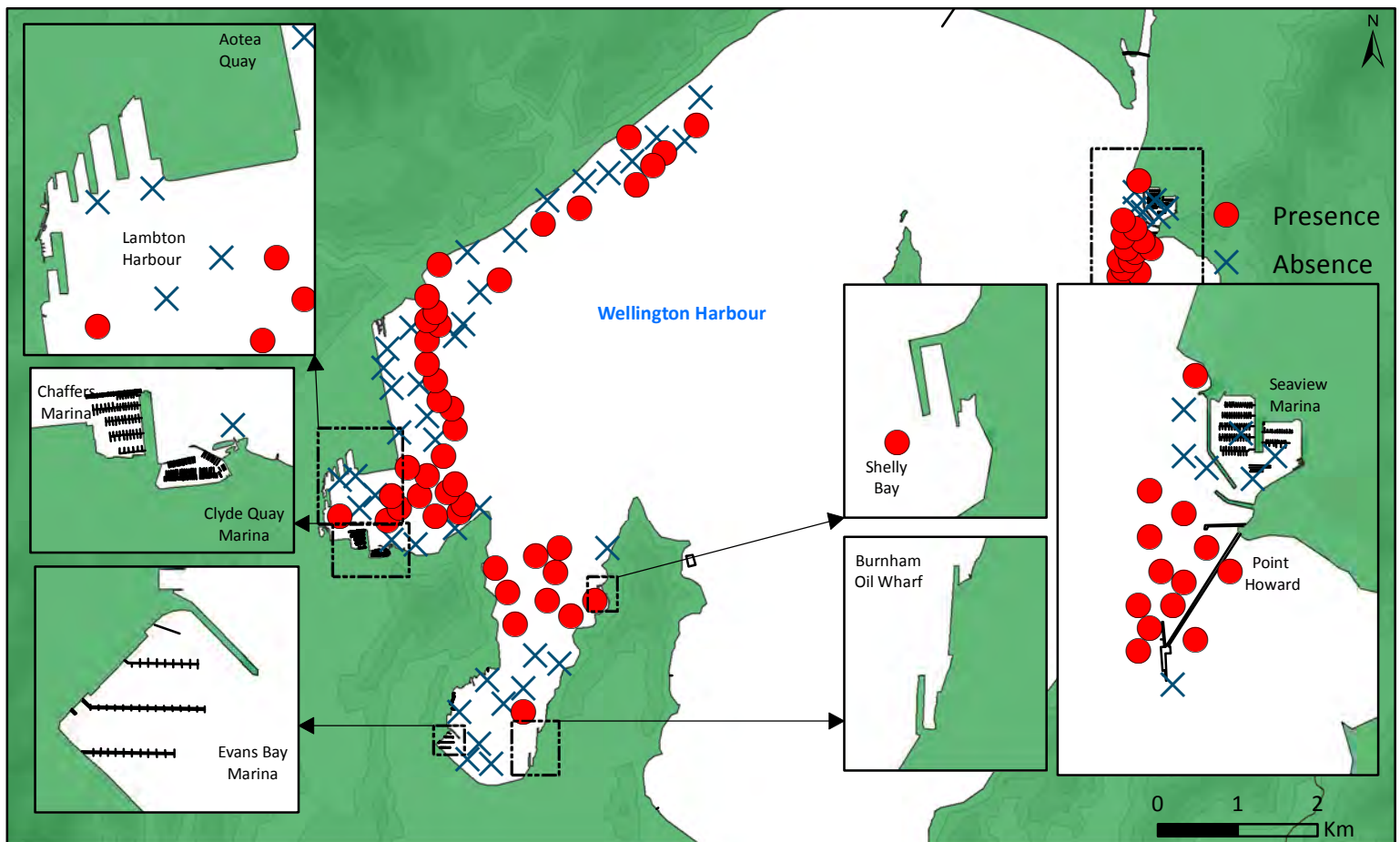
Halisarca dujardini



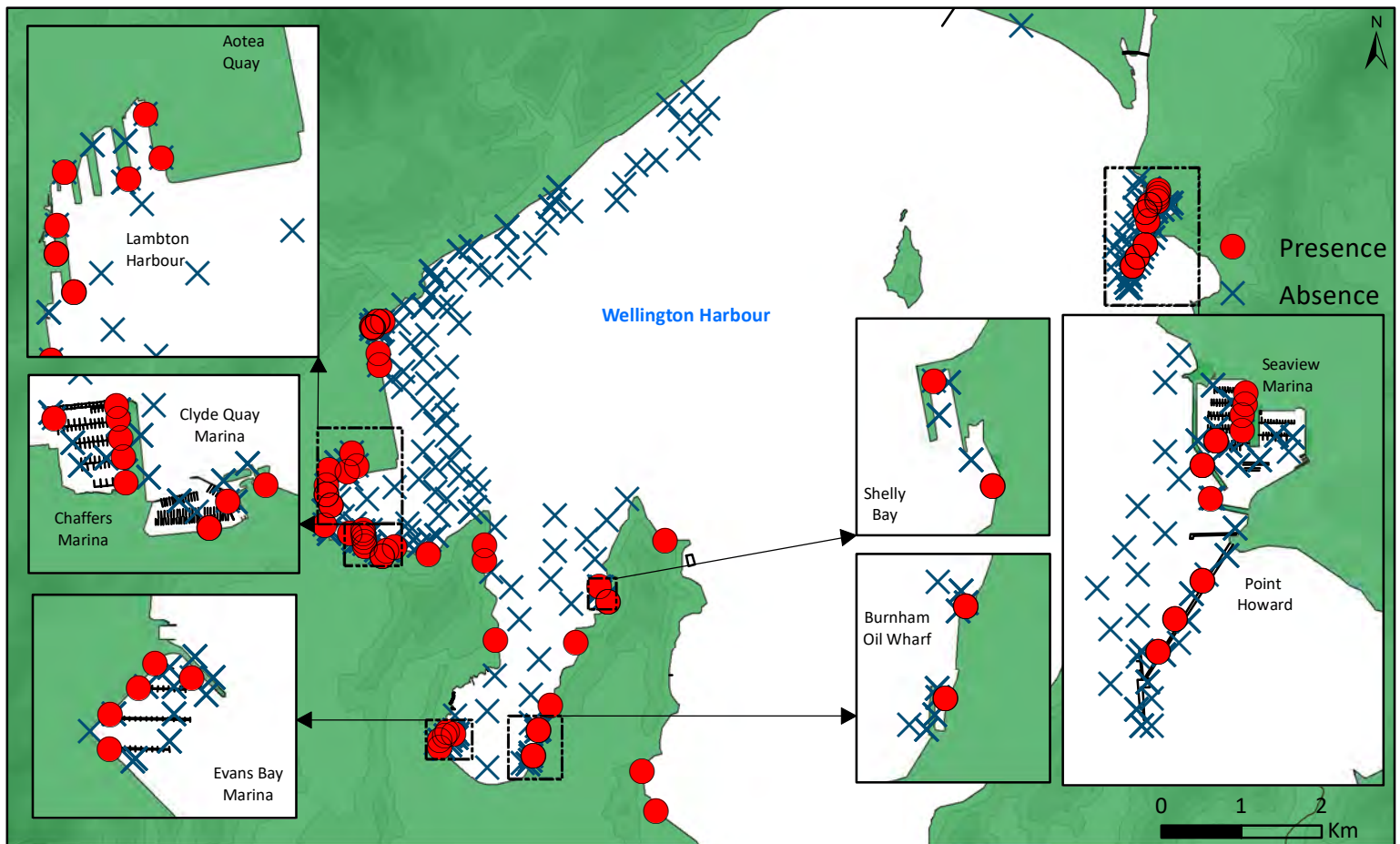
Wellington Harbour
Winter 2017
Theora lubrica



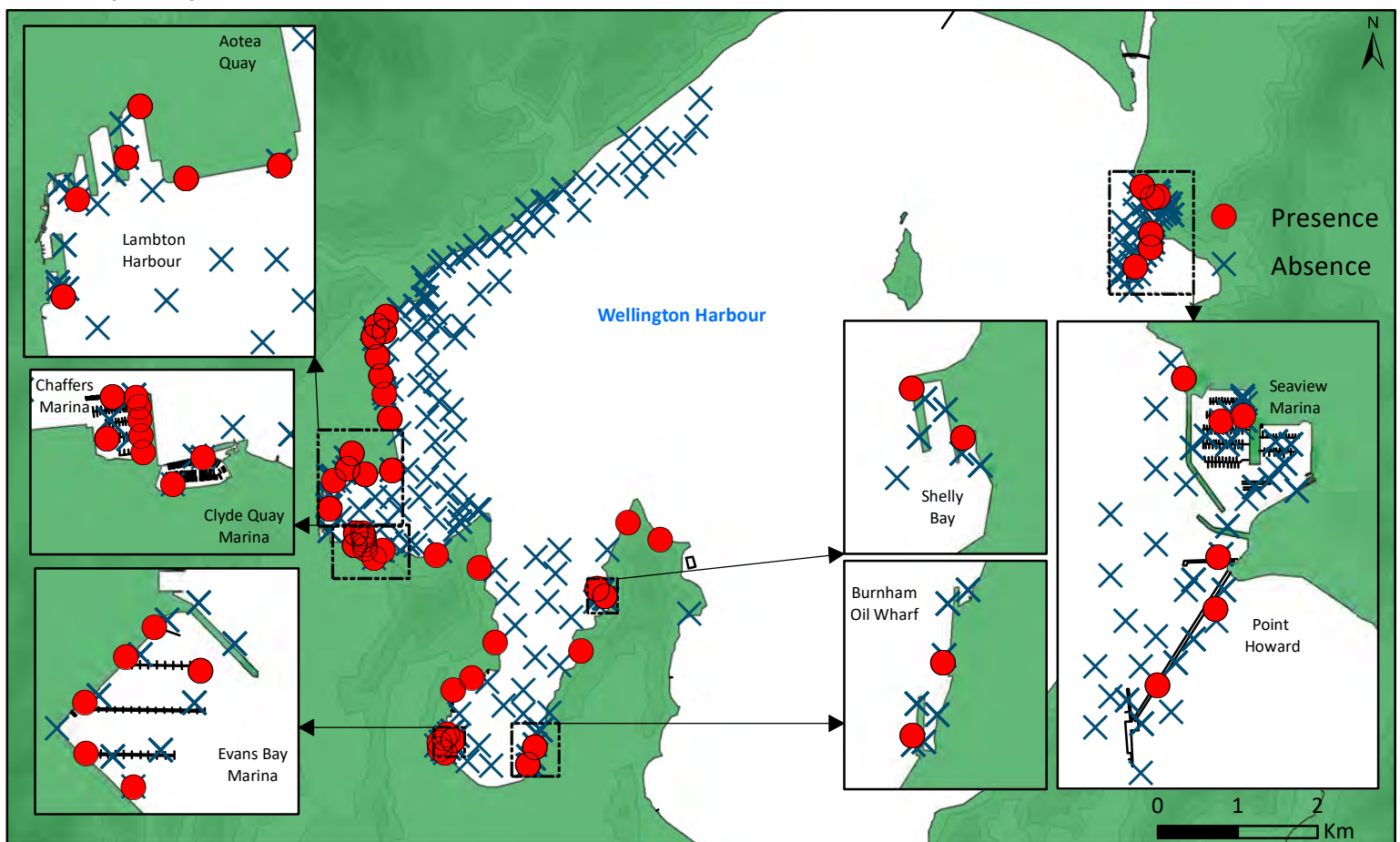
Wellington Harbour
Summer 2017-18
Theora lubrica



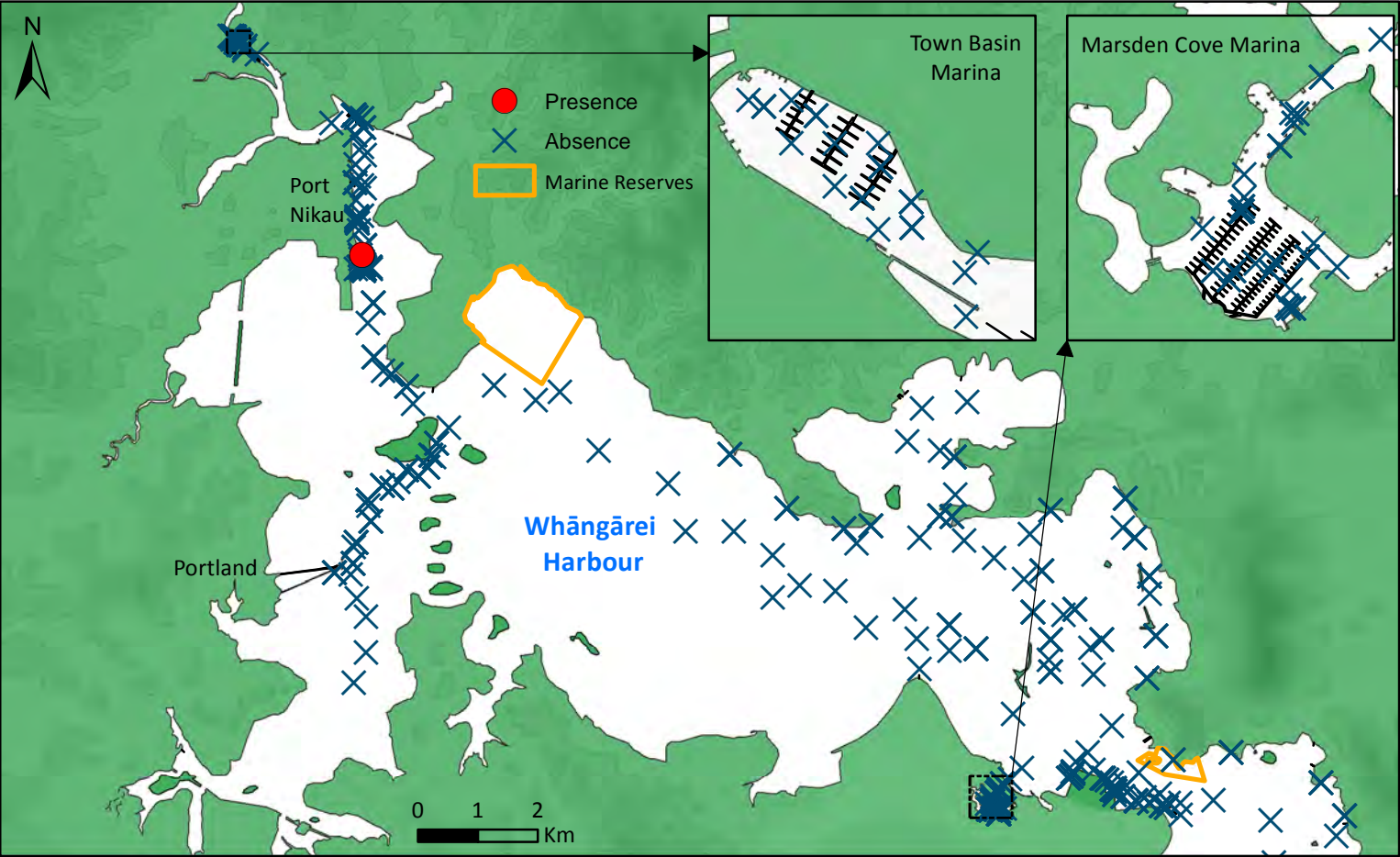
Wellington Harbour
Winter 2017
Undaria pinnatifida



Wellington Harbour
Summer 2017-18
Undaria pinnatifida



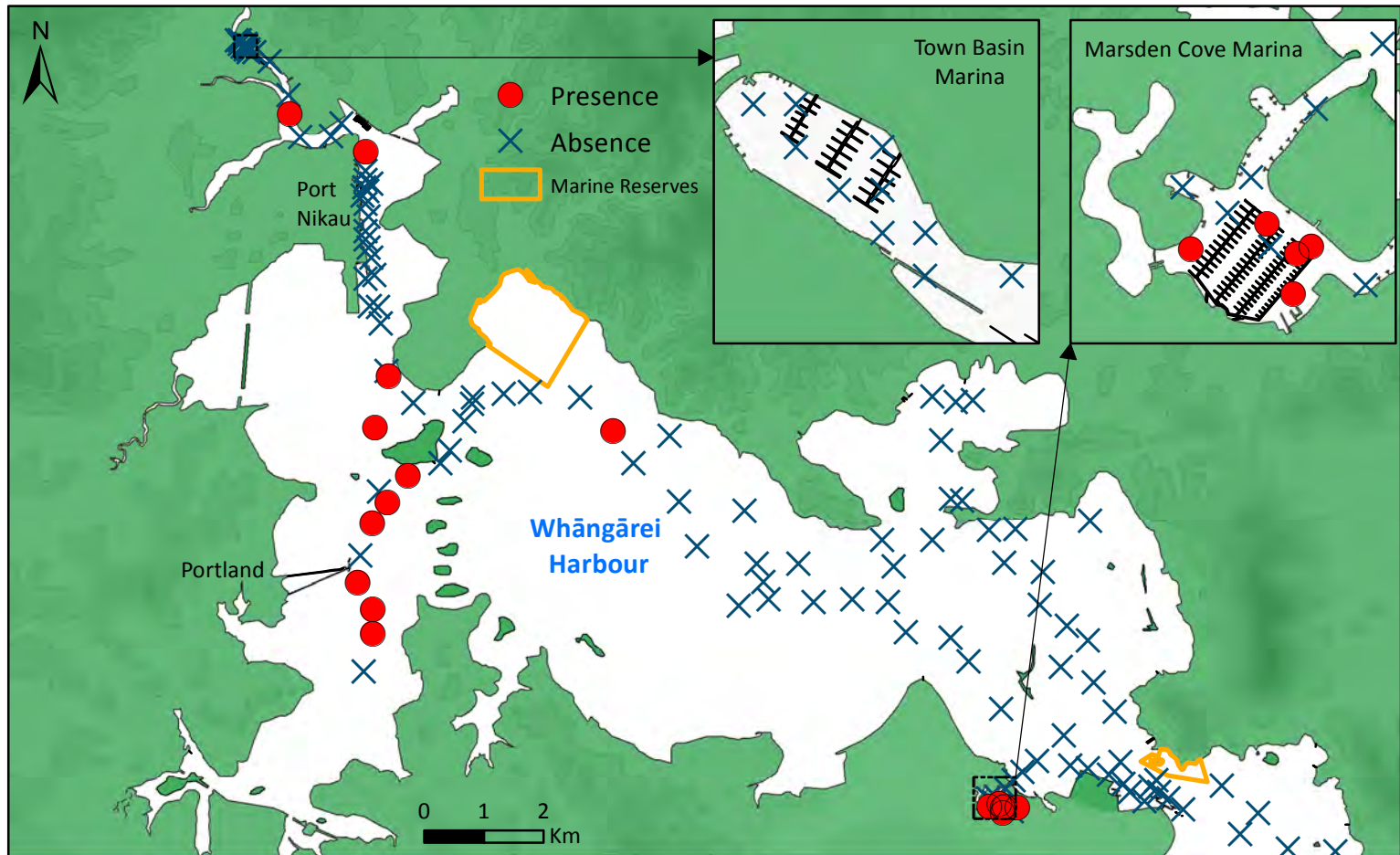
Whāngārei Harbour
Summer 2017-18
Acentrogobius pflaumii



Whāngārei Harbour

Winter 2017

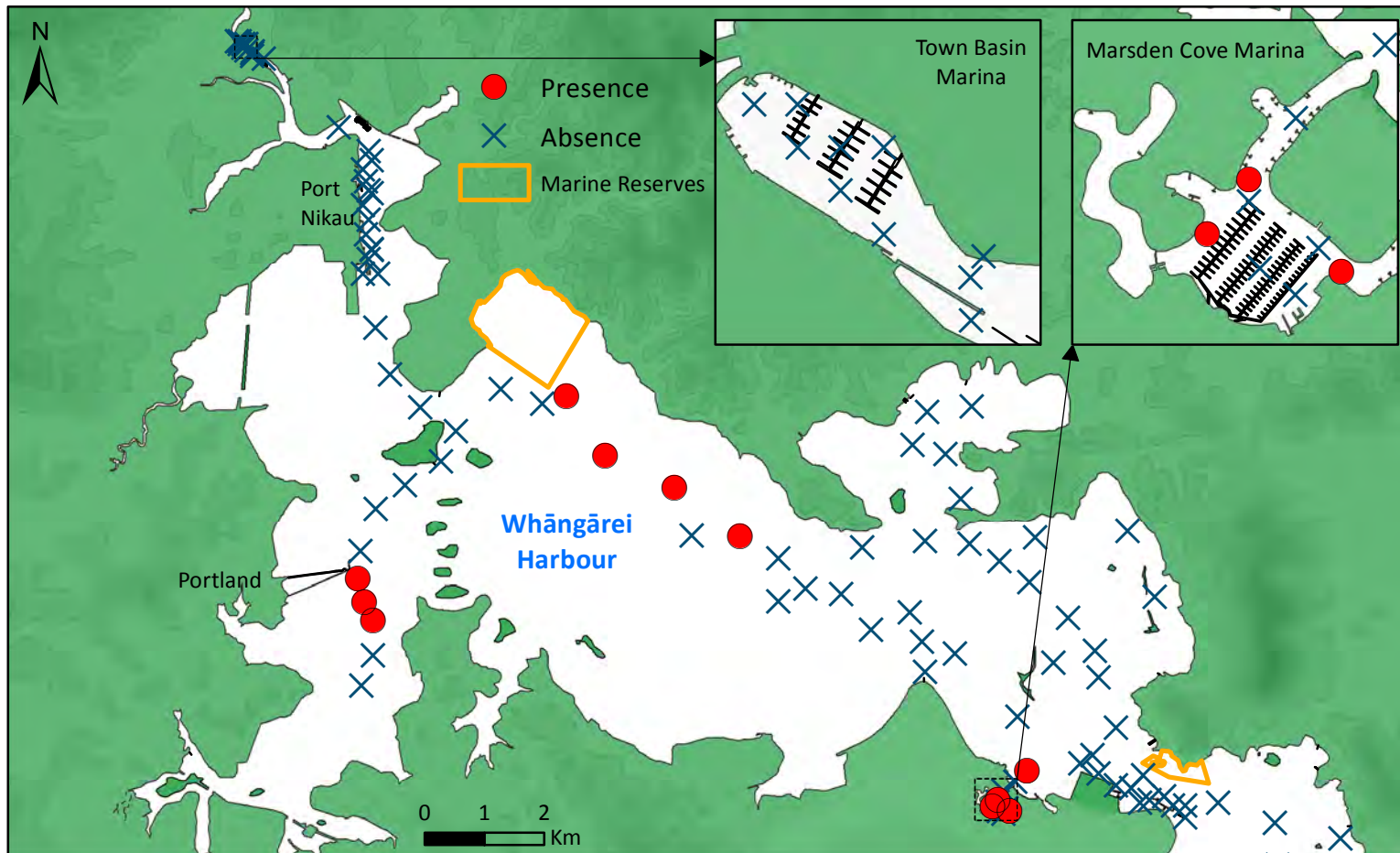
Arcuatula senhousia



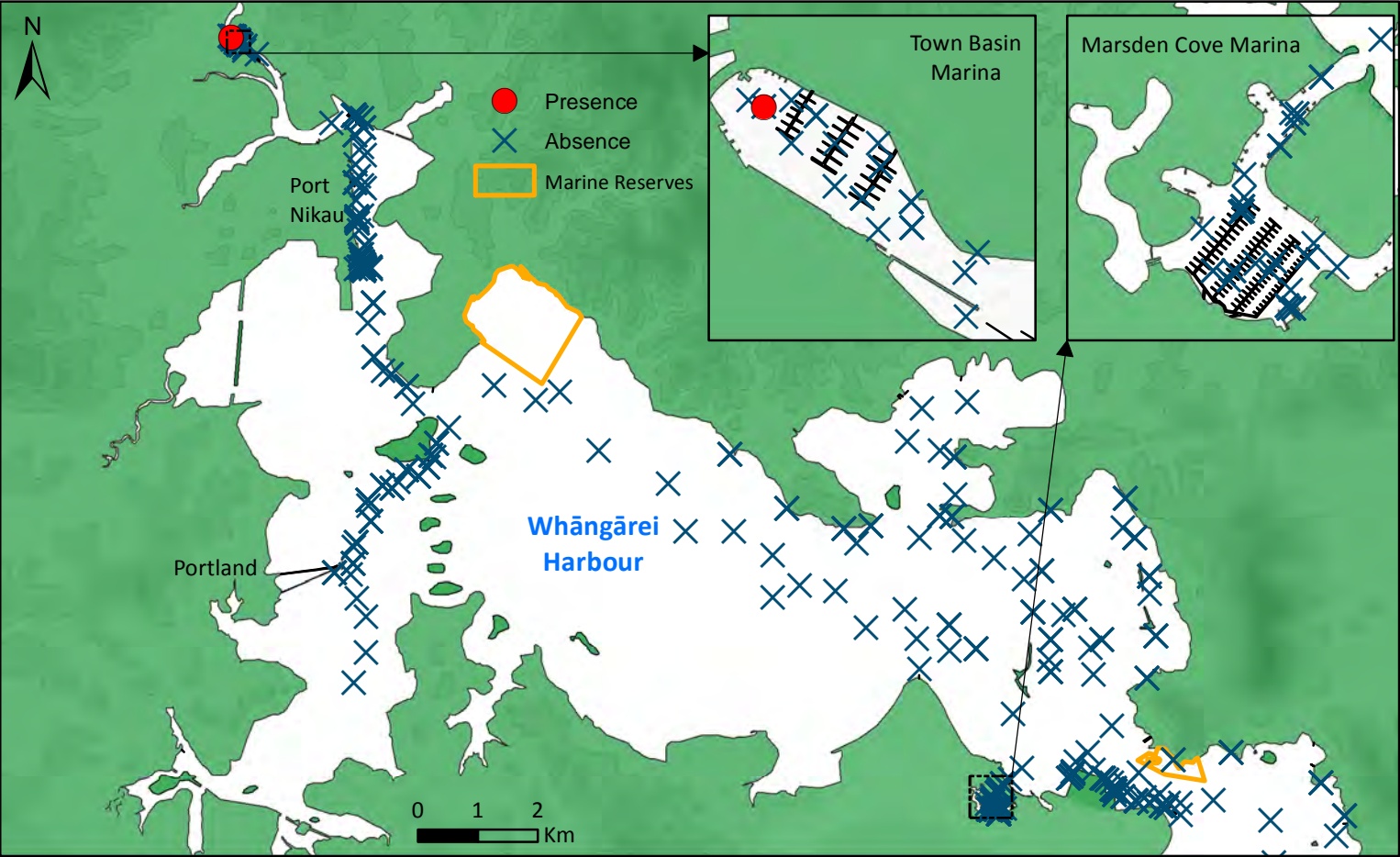
Whāngārei Harbour

Summer 2017-18

Arcuatula senhousia



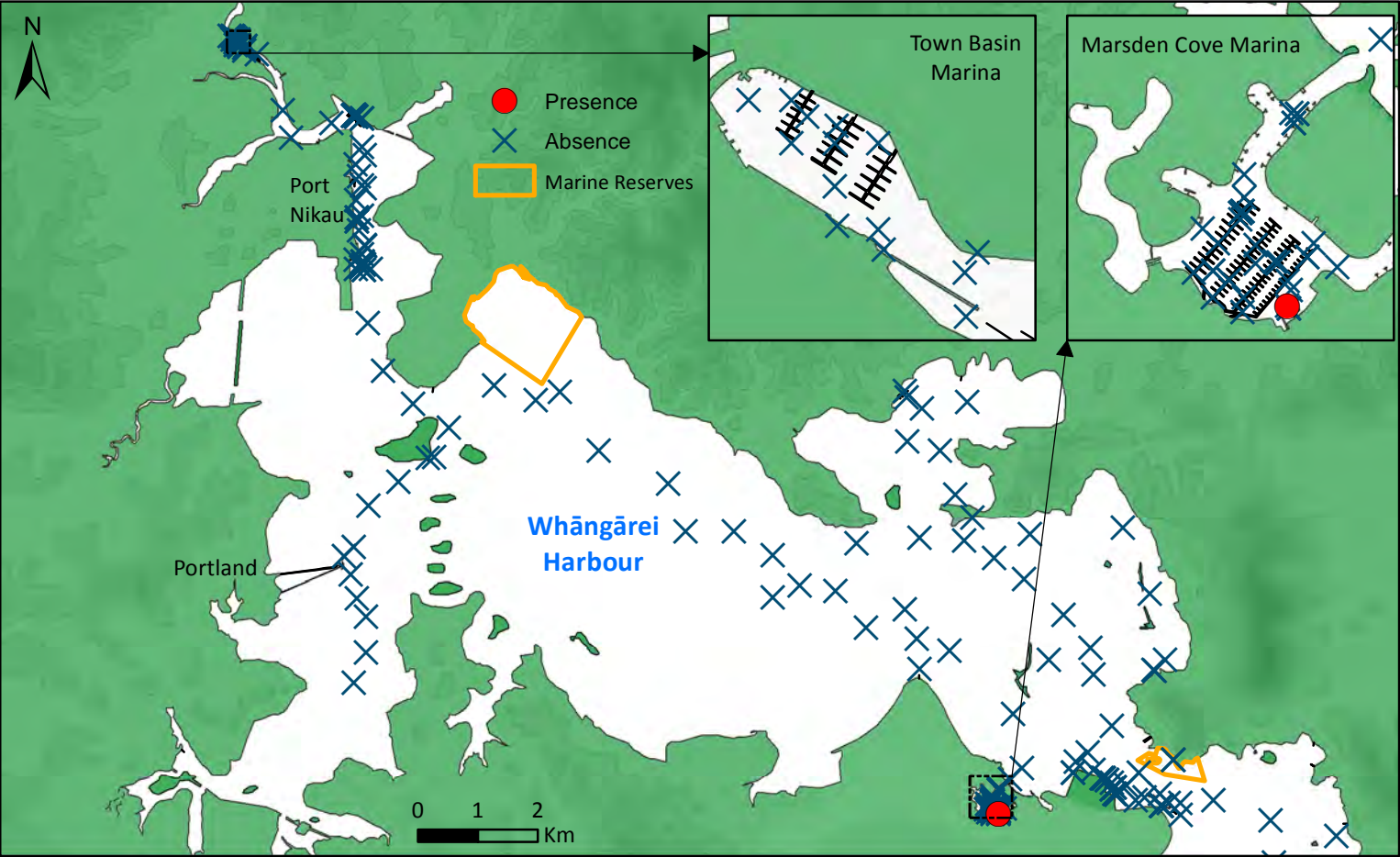
Whāngārei Harbour
Summer 2017-18
Arenigobius bifrenatus



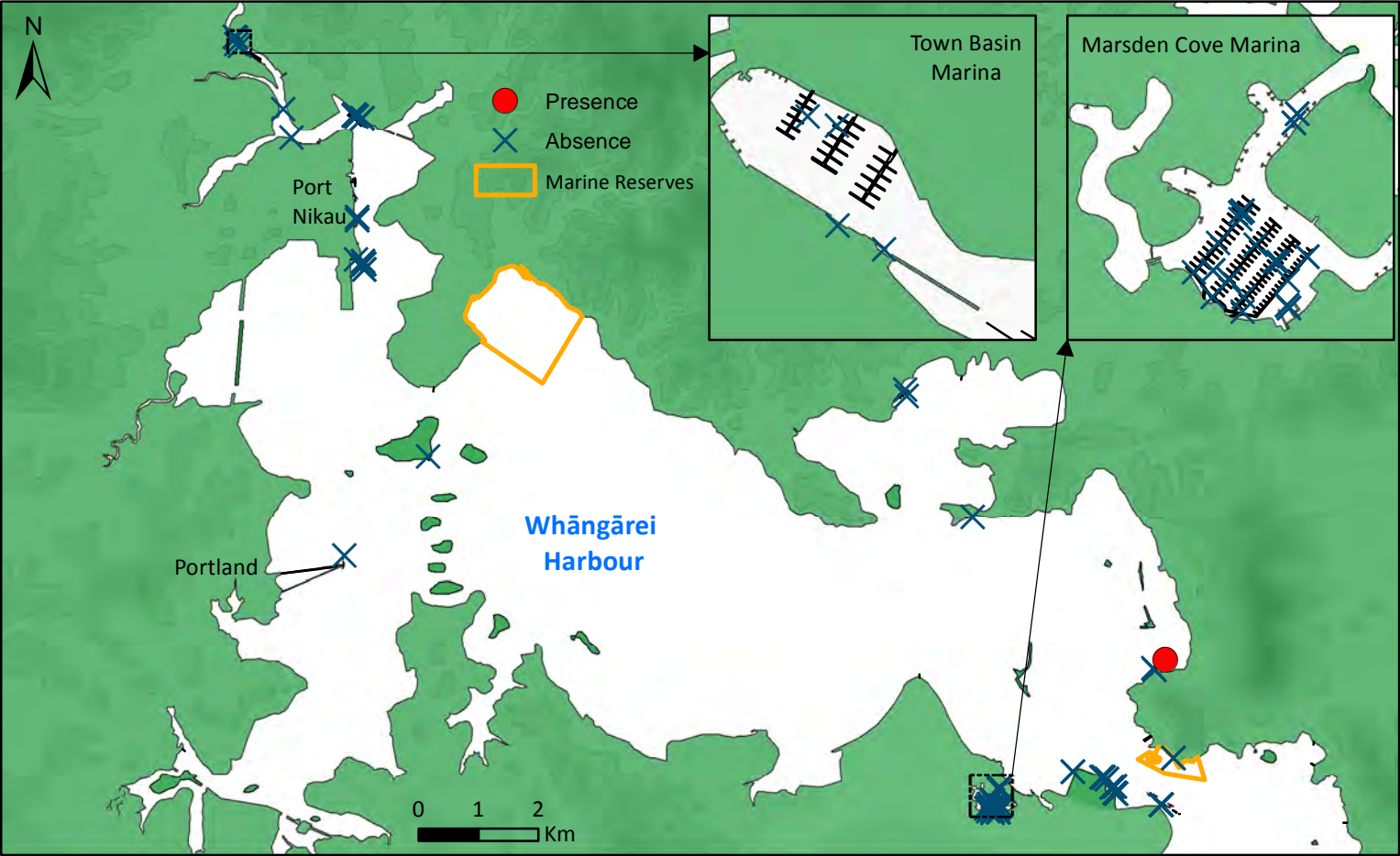
Whāngārei Harbour

Summer 2017-18

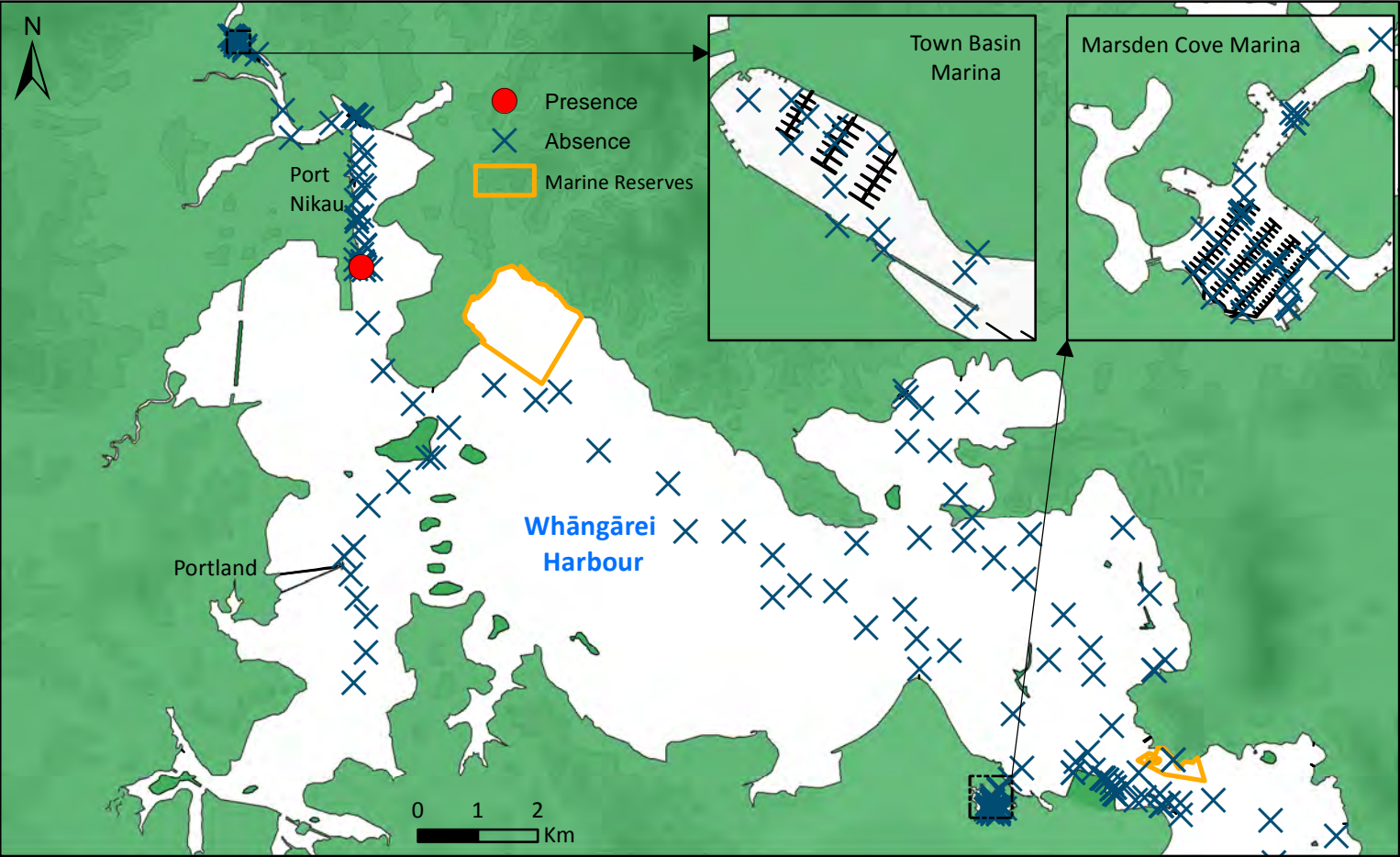
Ascidrella aspersa



Whāngārei Harbour
Summer 2017-18
Caprella scauroides



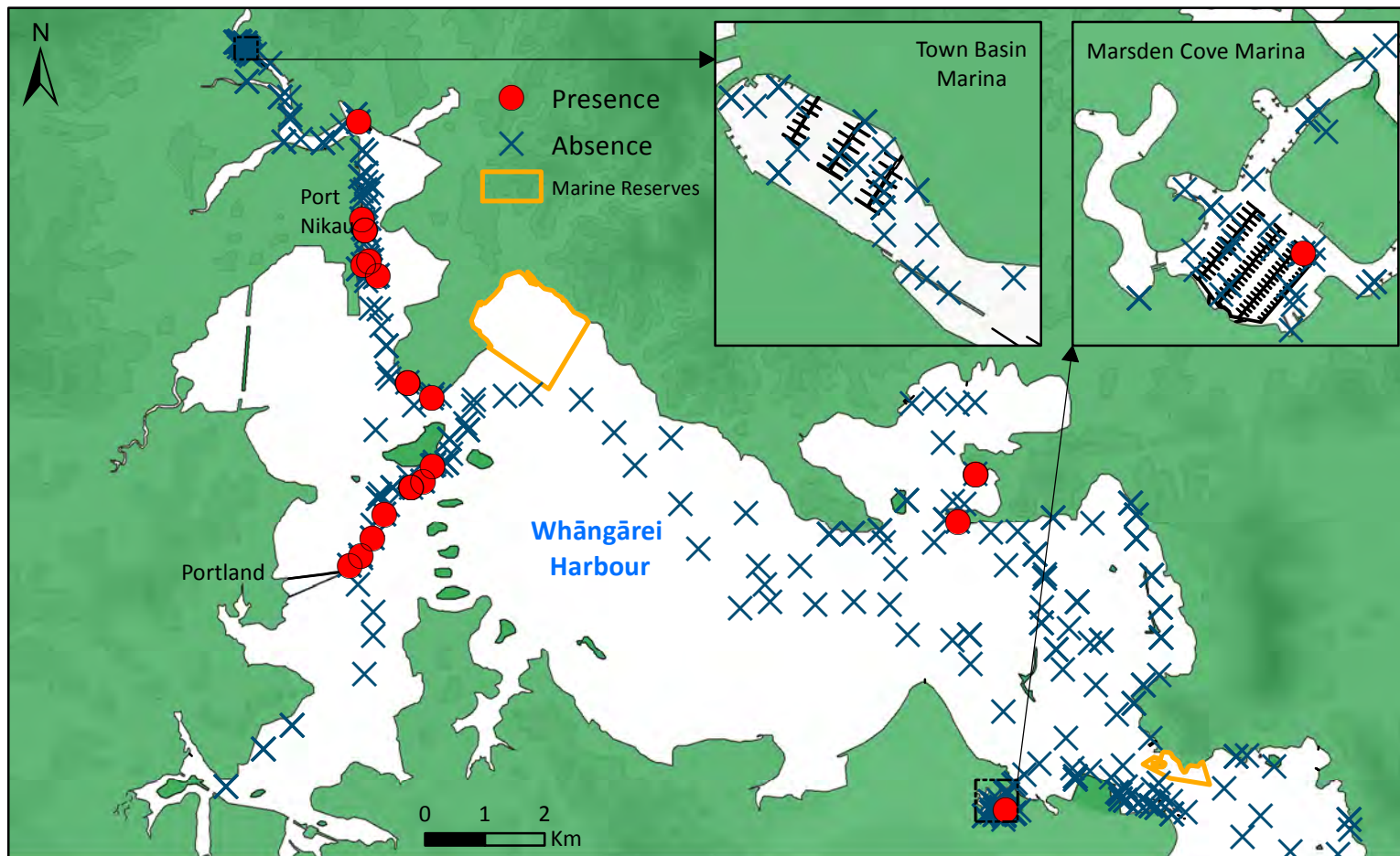
Whāngārei Harbour
Summer 2017-18
Celleporaria nodulosa



Whāngārei Harbour

Winter 2017

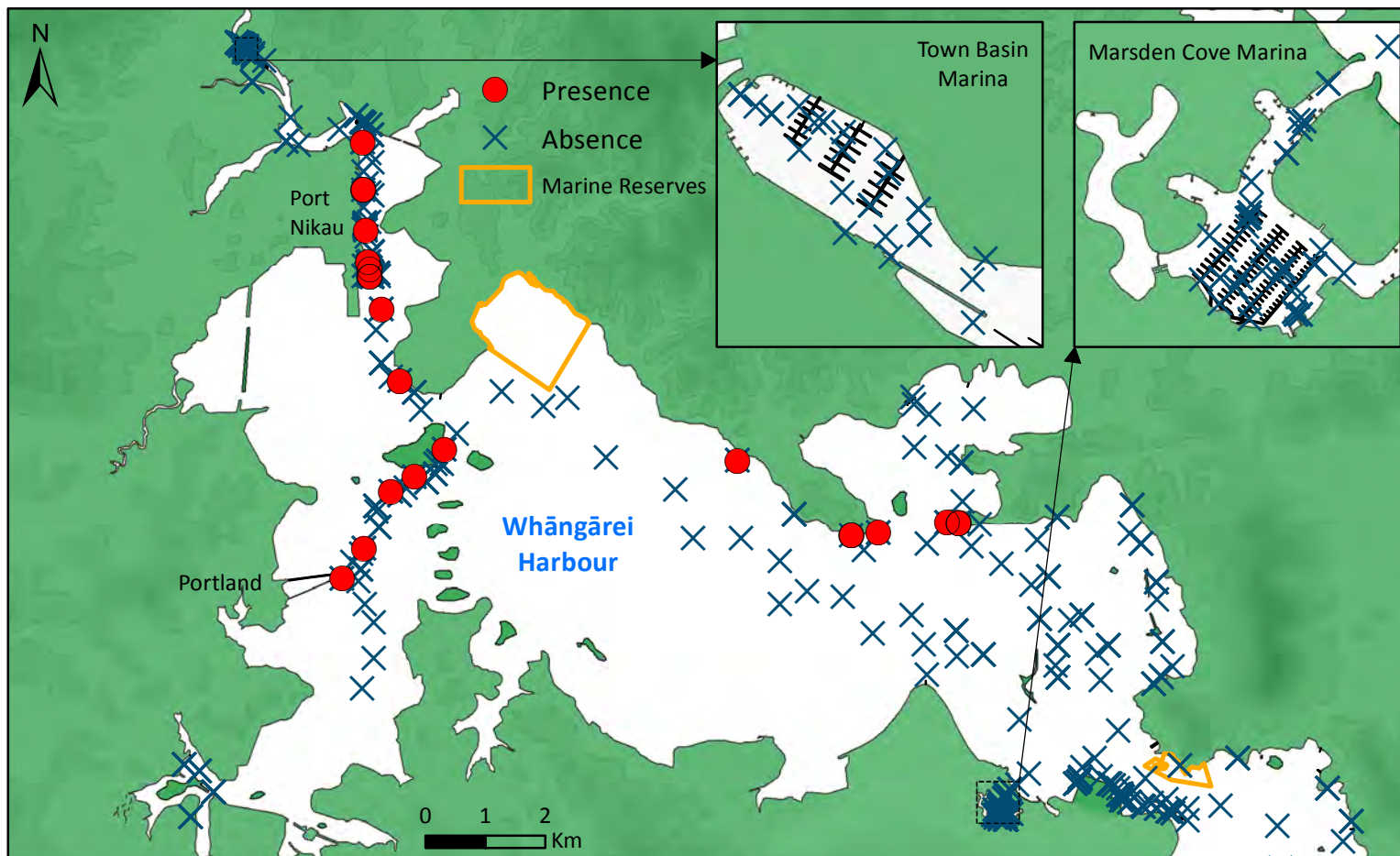
Charybdis (Charybdis) japonica



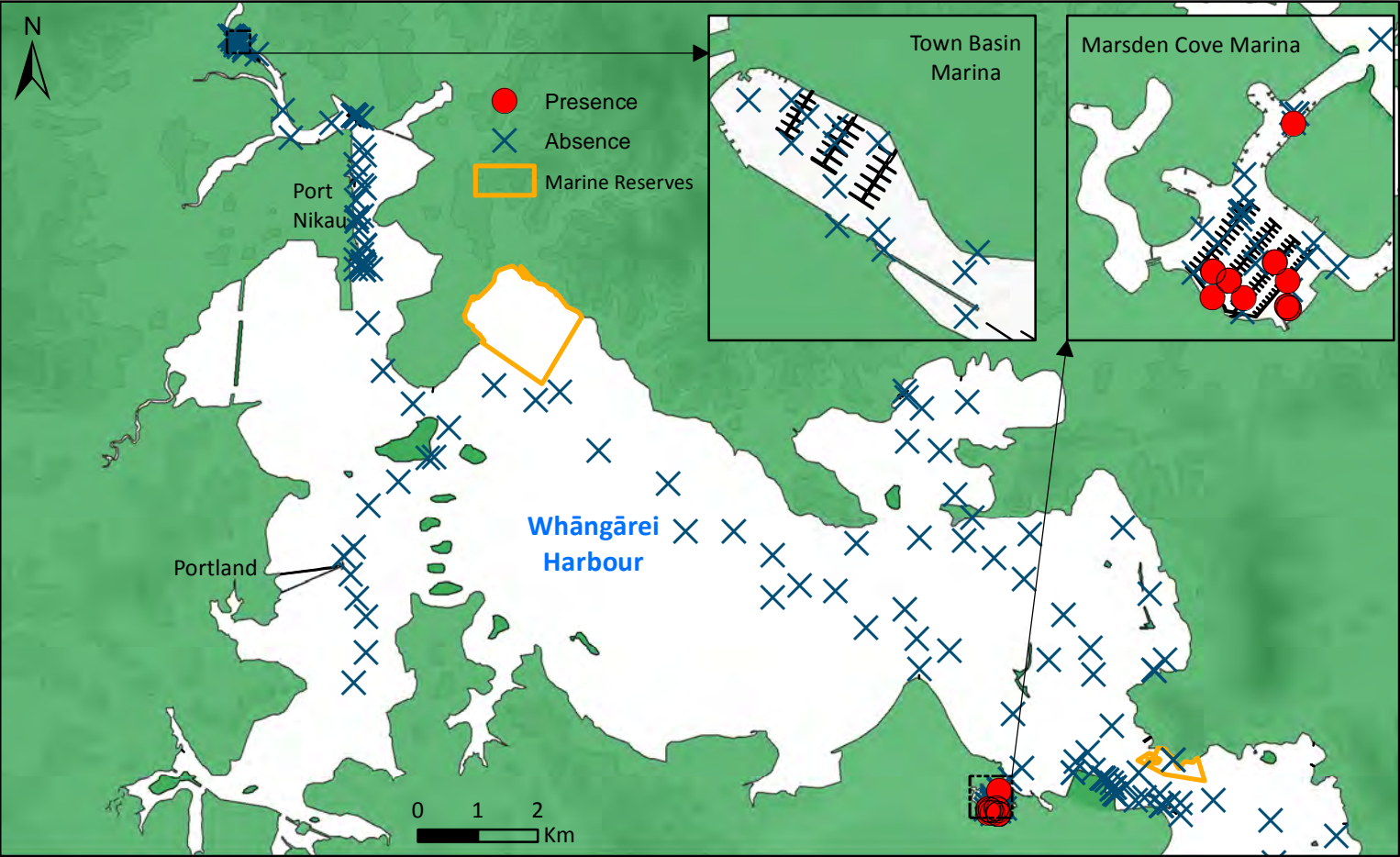
Whāngārei Harbour

Summer 2017-18

Charybdis (Charybdis) japonica



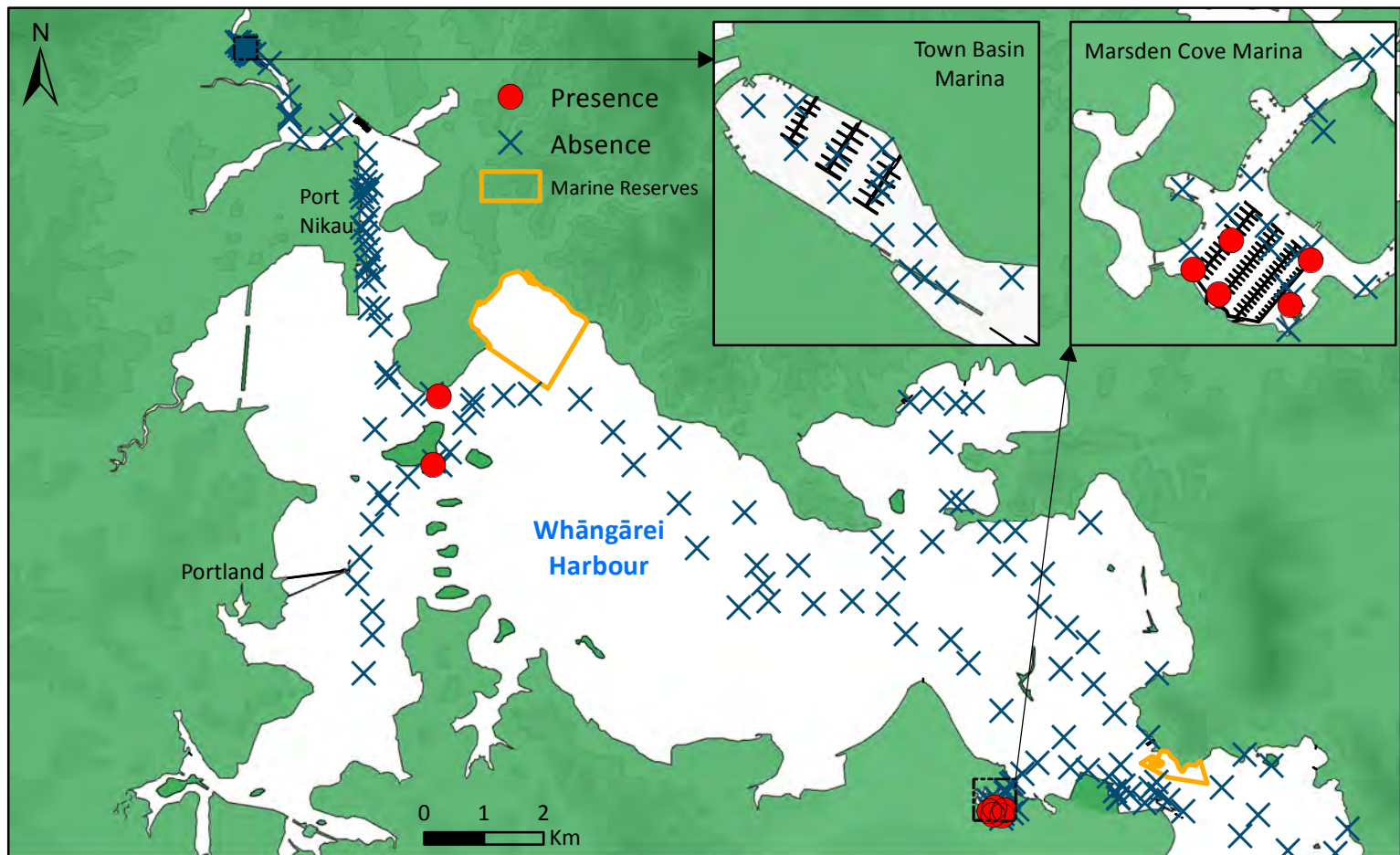
Whāngārei Harbour
Summer 2017-18
Ciona spp.



Whāngārei Harbour

Winter 2017

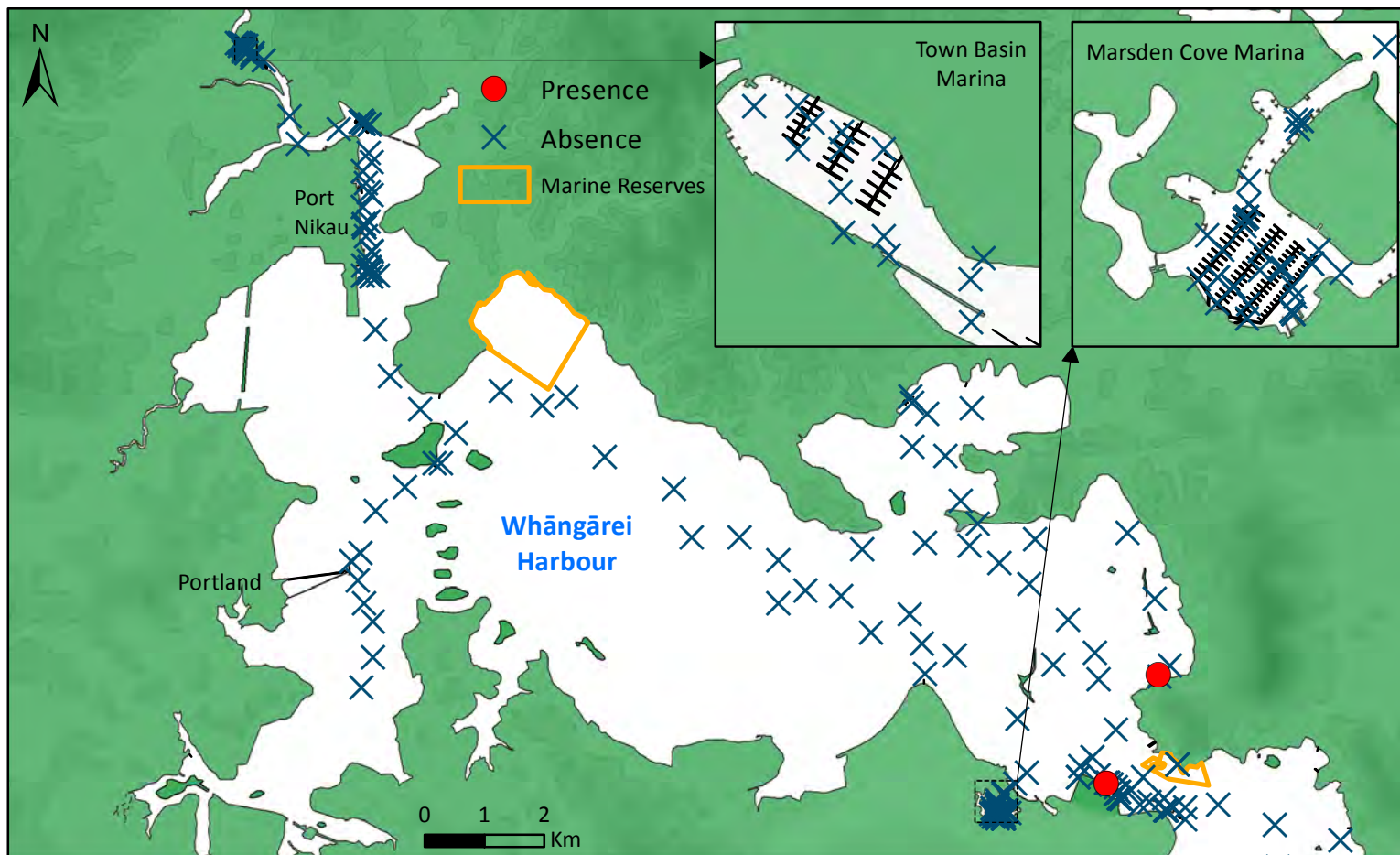
Didemnum vexillum



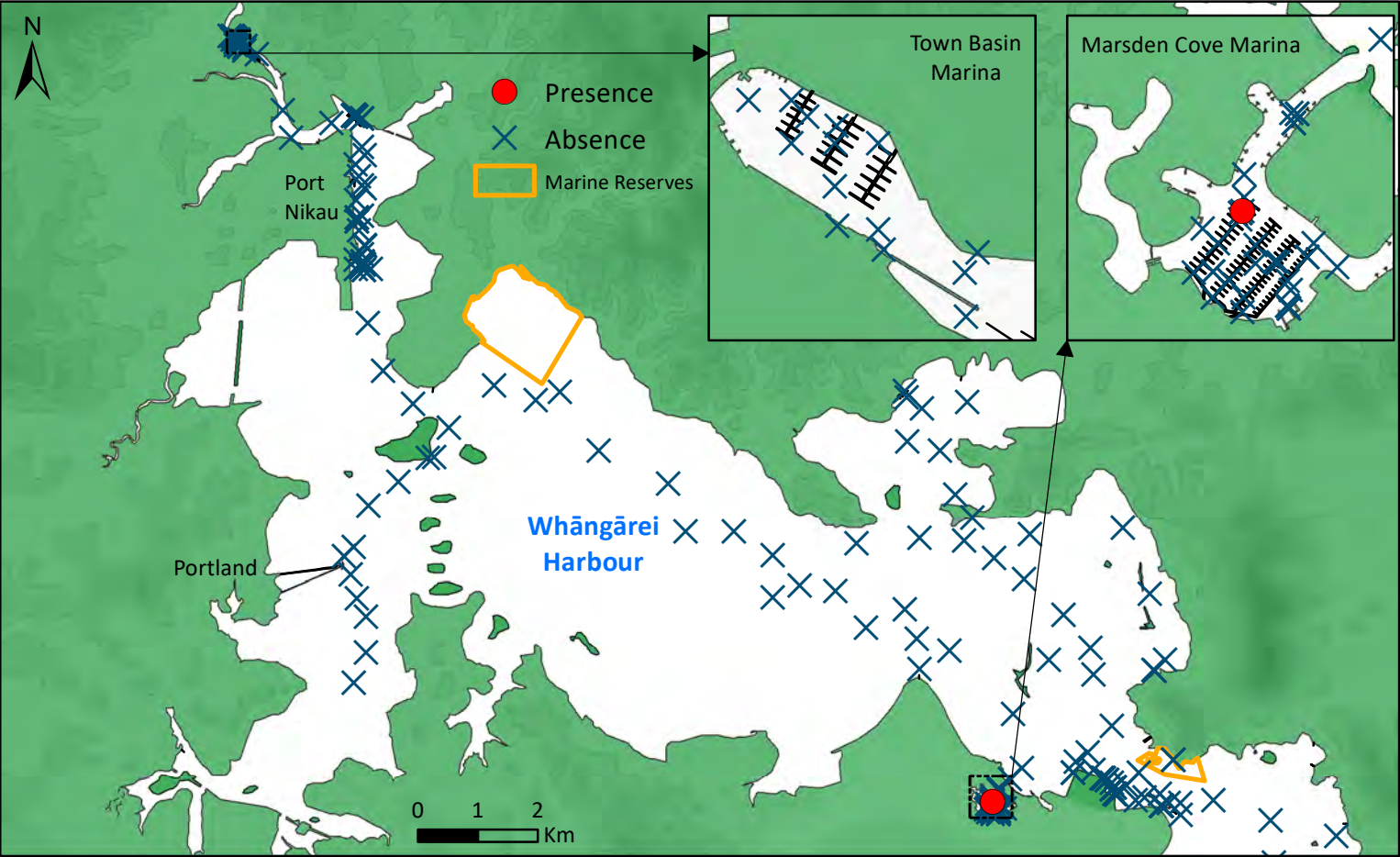
Whāngārei Harbour

Summer 2017-18

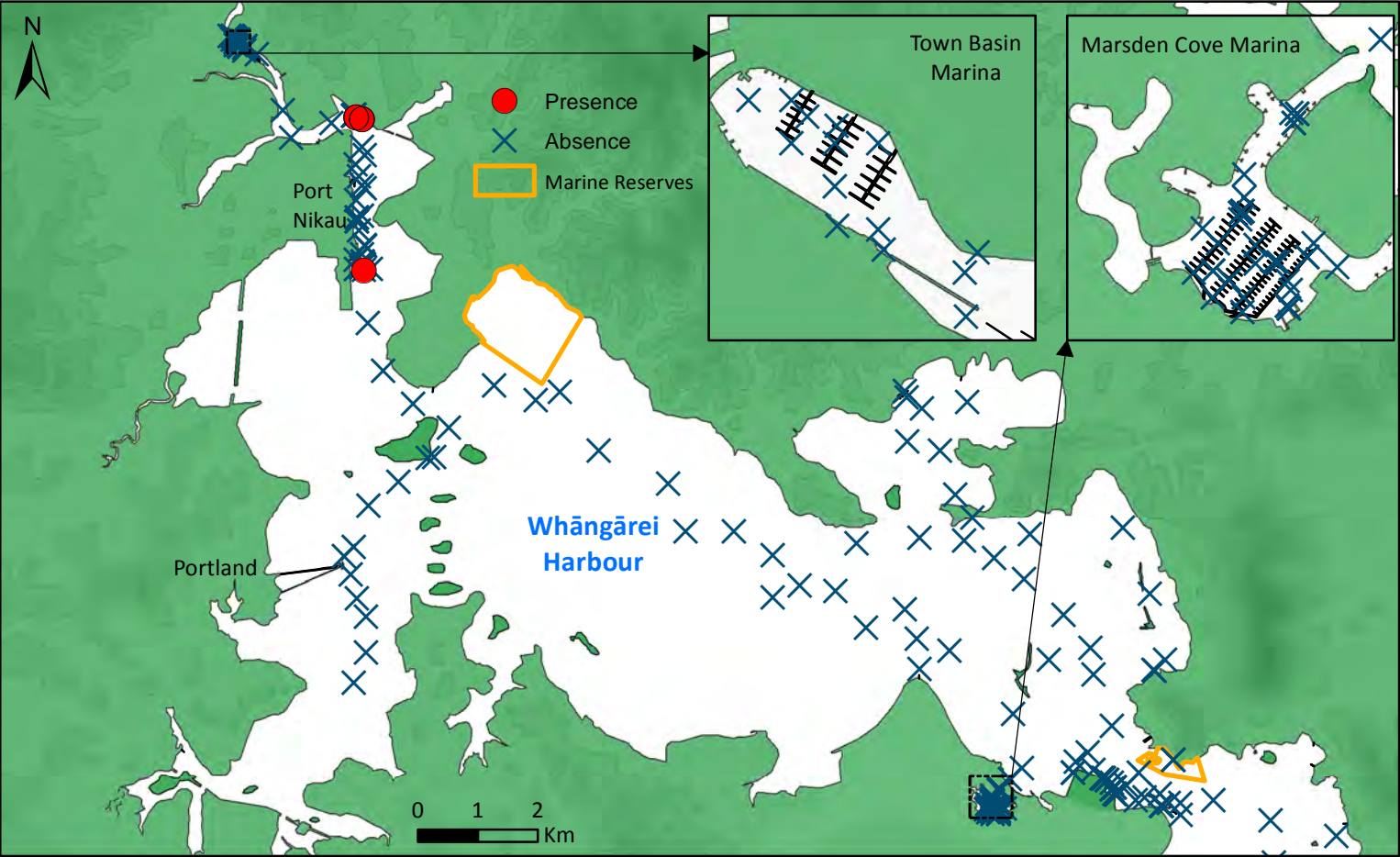
Didemnum vexillum



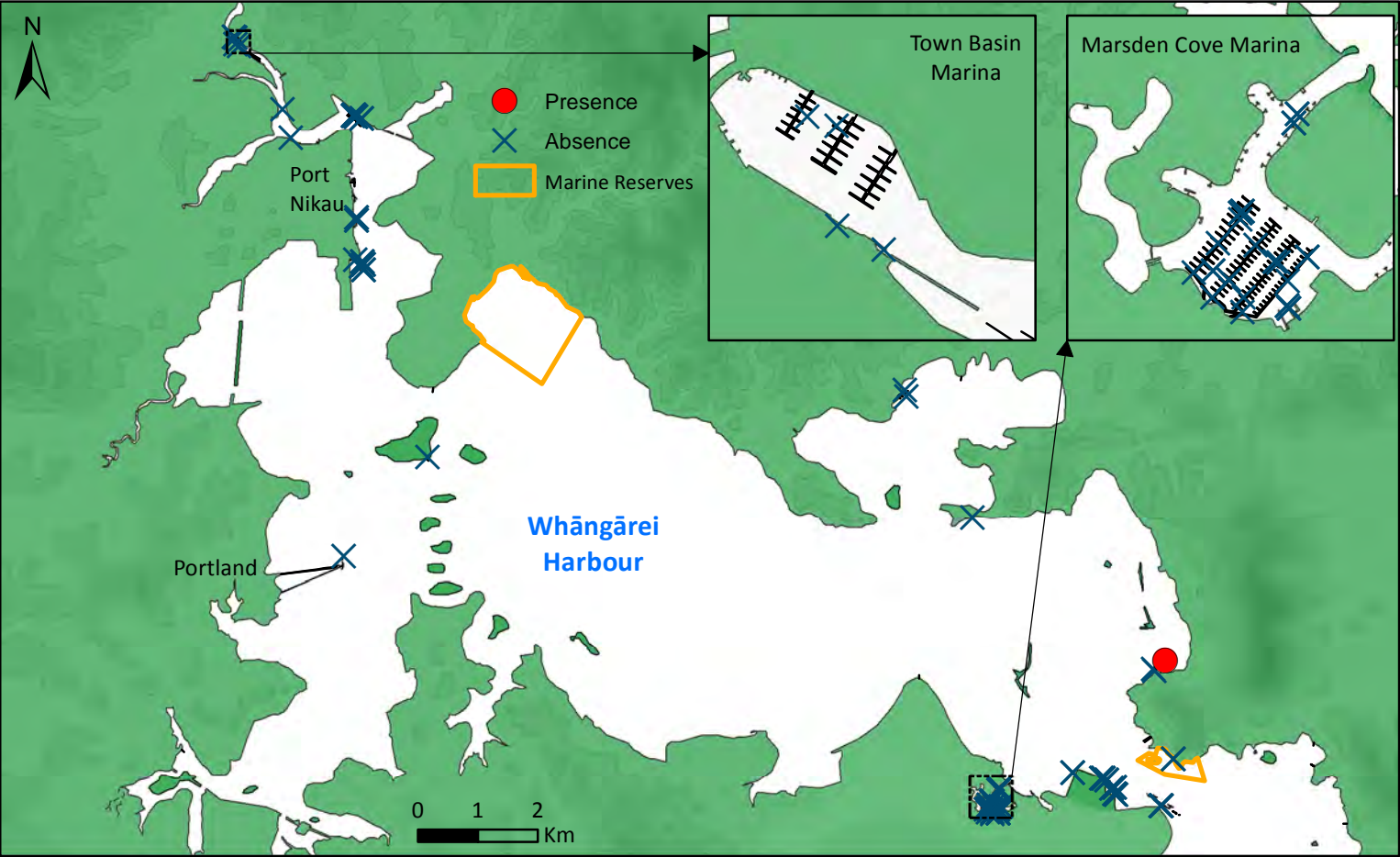
Whāngārei Harbour
Summer 2017-18
Diplosoma listerianum



Whāngārei Harbour
Summer 2017-18
Eudistoma elongatum



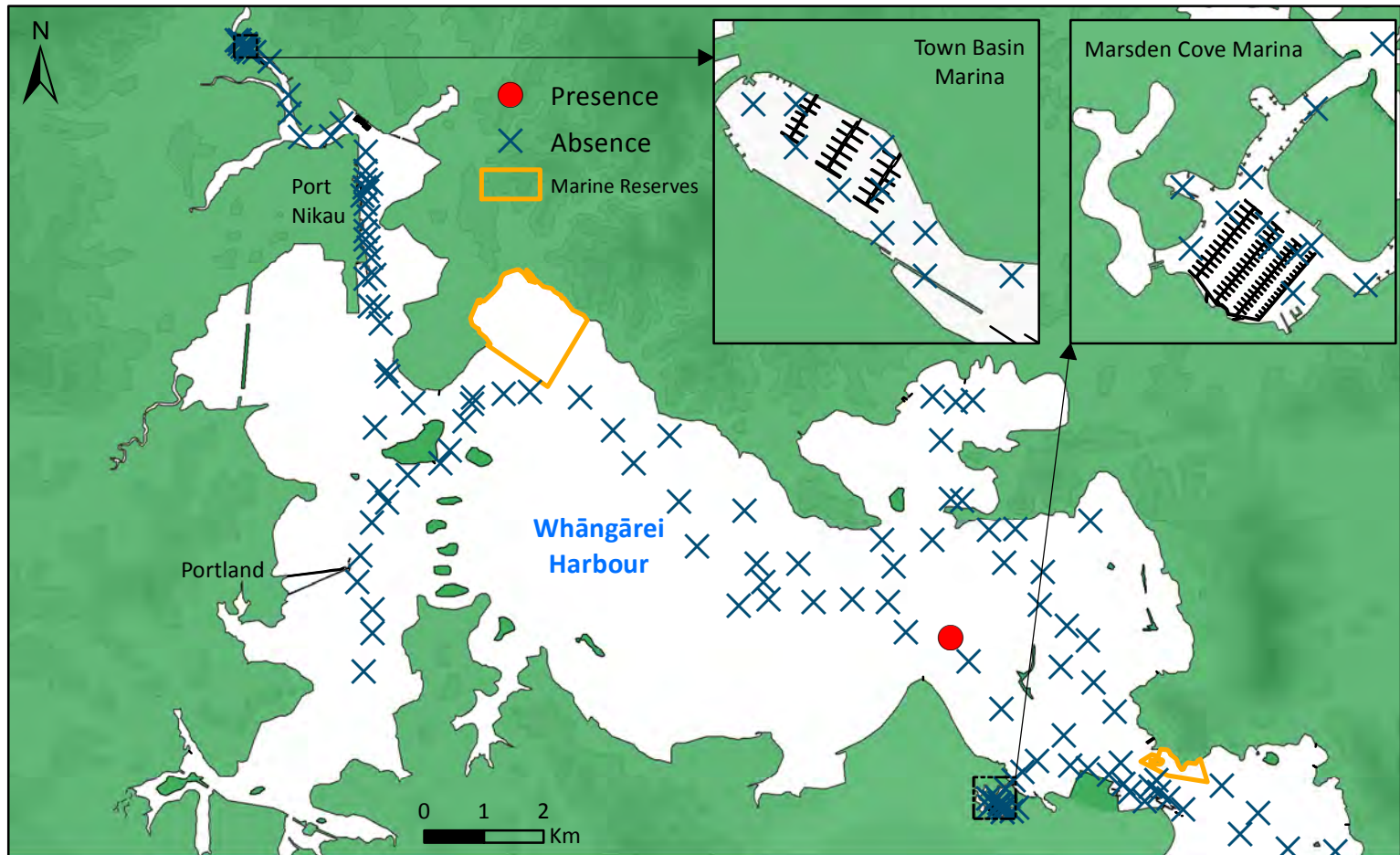
Whāngārei Harbour
Summer 2017-18
Jassa slatteryi



Whāngārei Harbour

Winter 2017

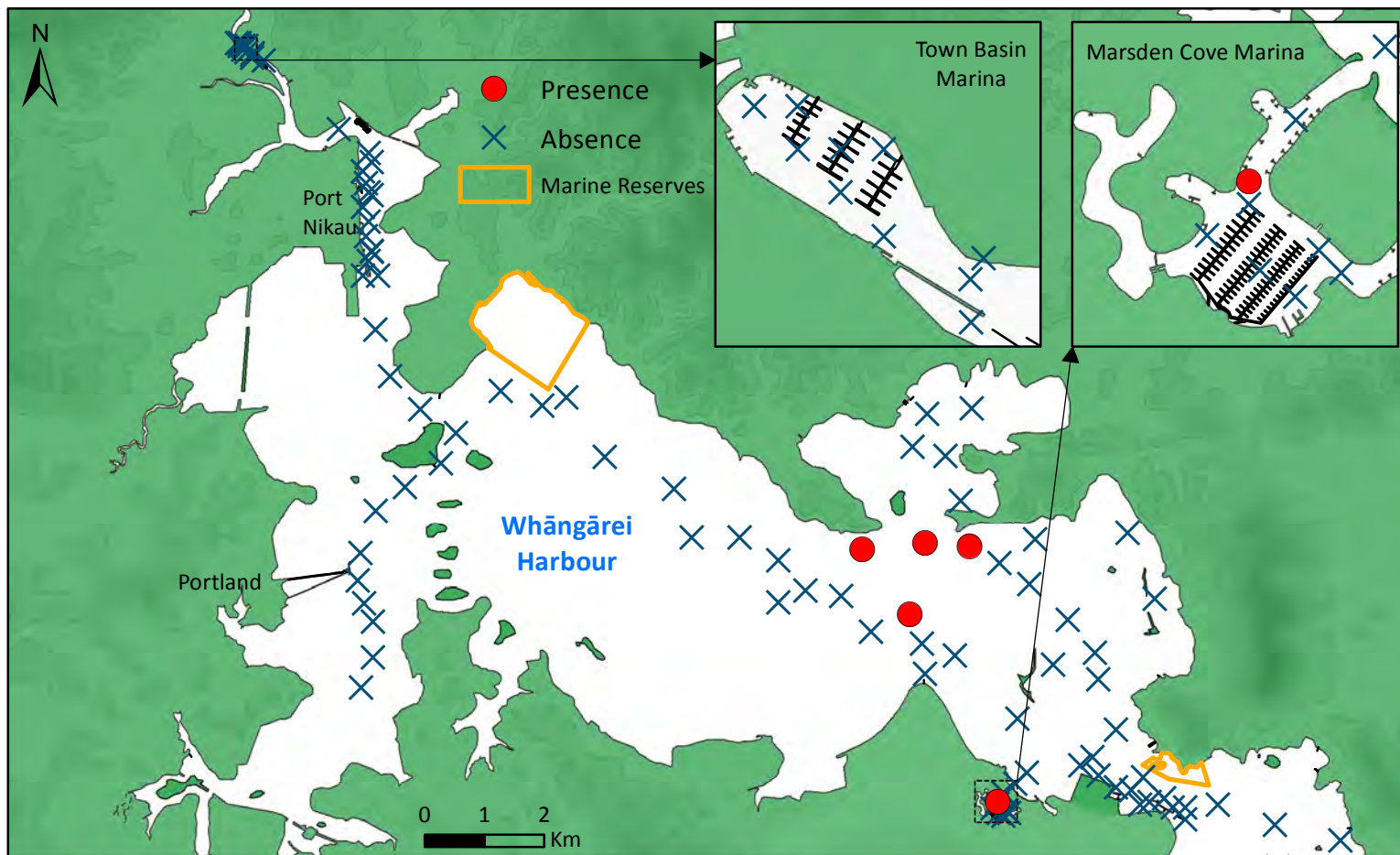
Limaria orientalis



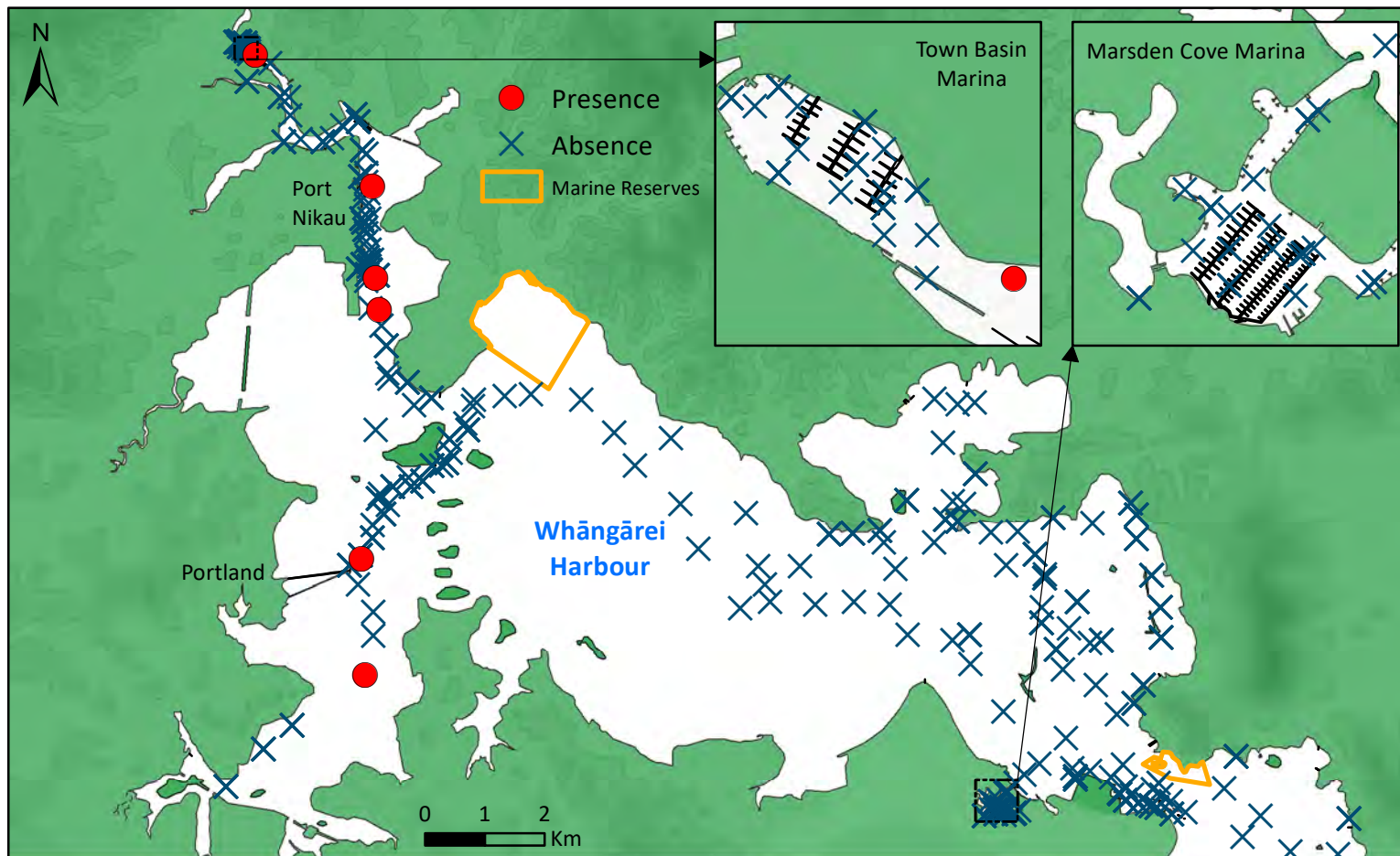
Whāngārei Harbour

Summer 2017-18

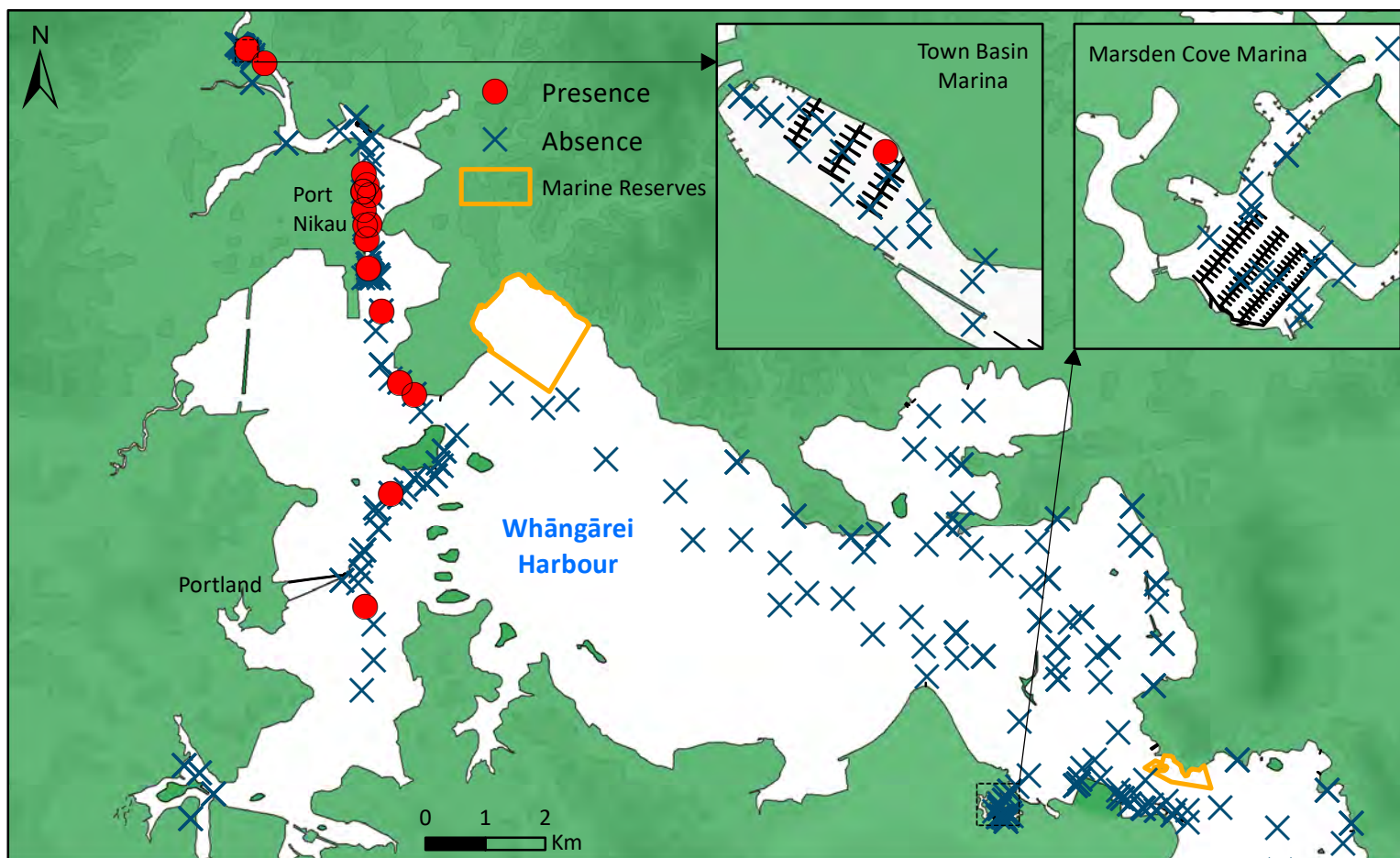
Limaria orientalis



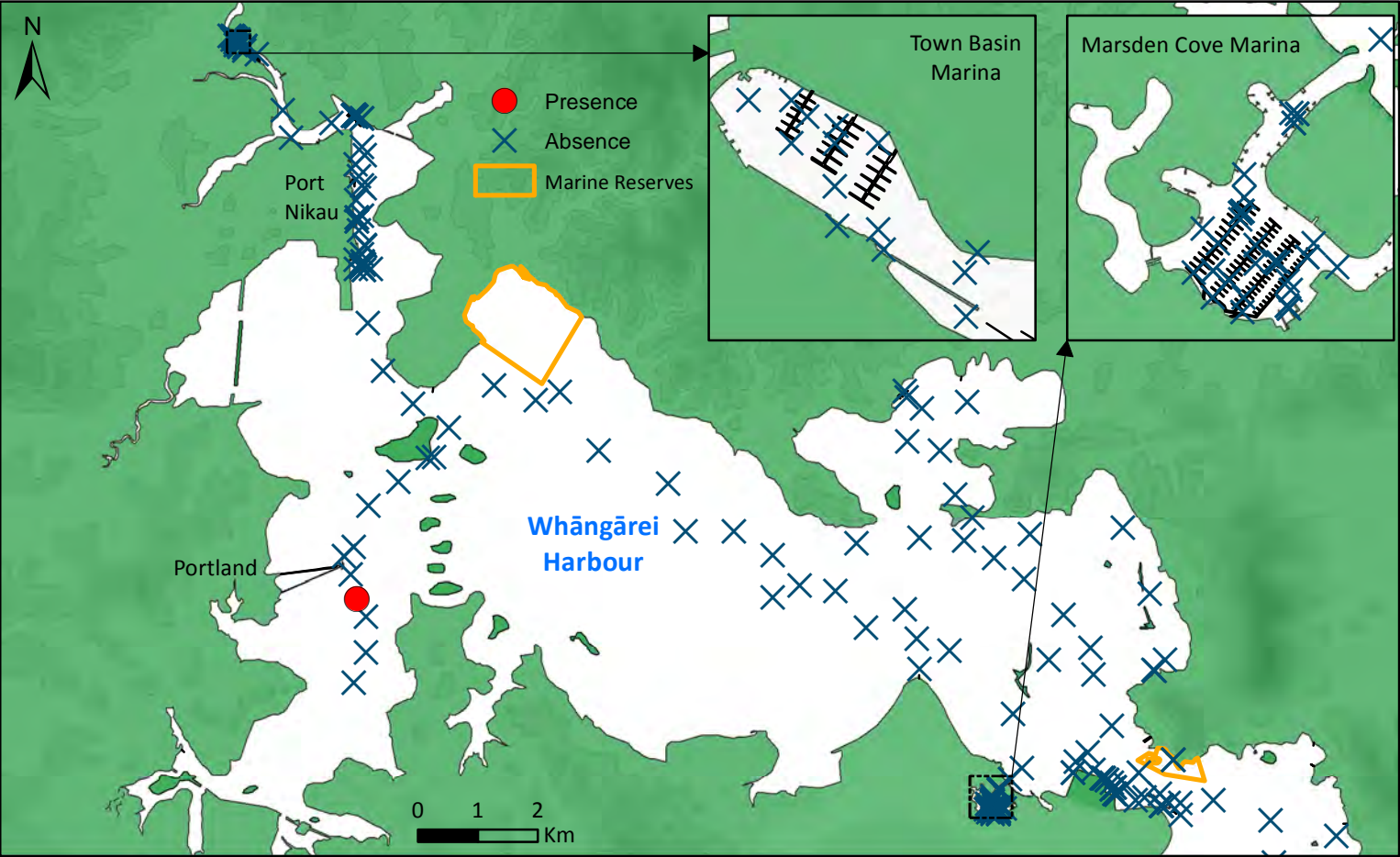
Whāngārei Harbour
Winter 2017
Metapenaeus bennettiae



Whāngārei Harbour
Summer 2017-18
Metapenaeus bennettiae



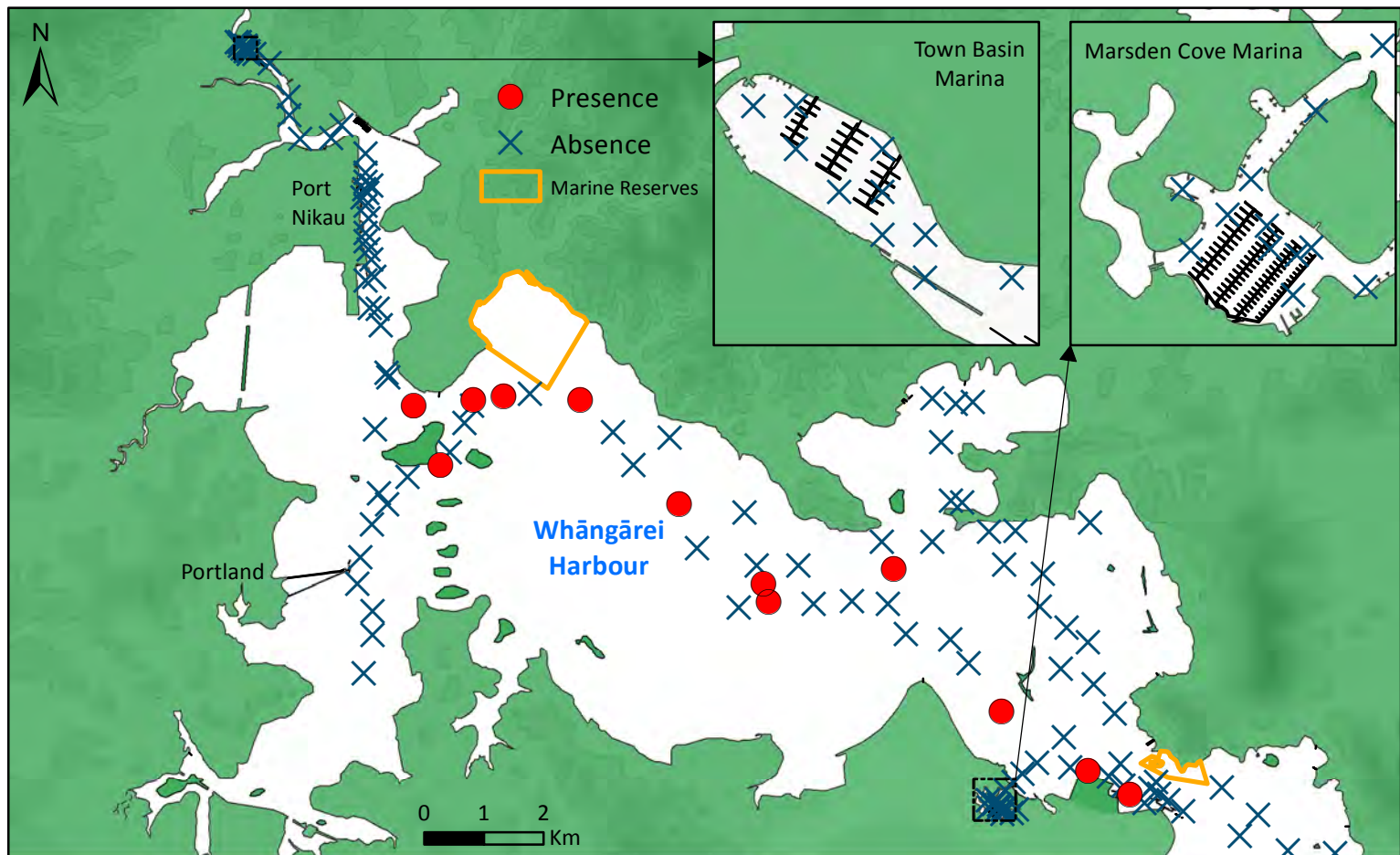
Whāngārei Harbour
Summer 2017-18
Paralepidonotus ampulliferus



Whāngārei Harbour

Winter 2017

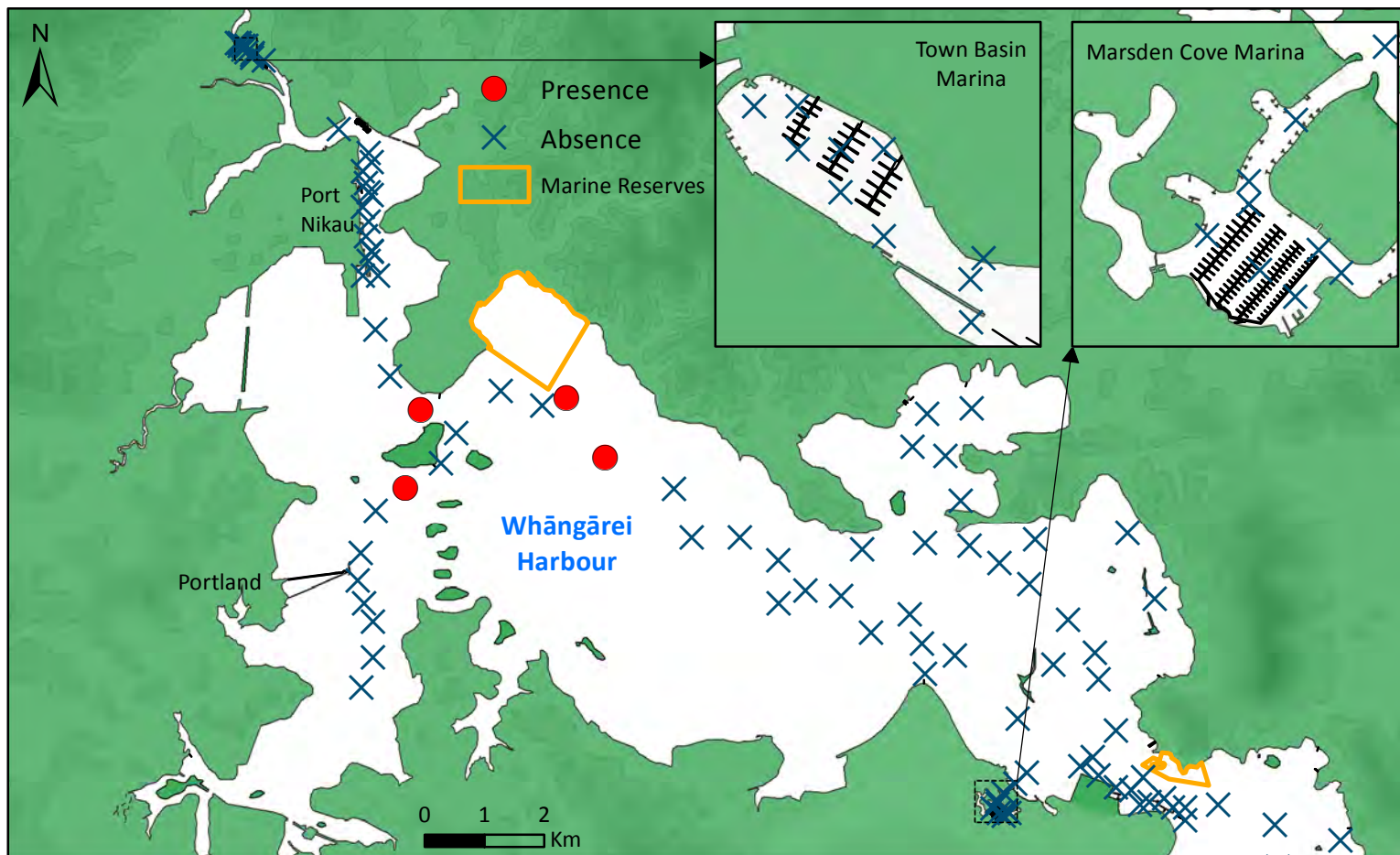
Pyromaia tuberculata



Whāngārei Harbour

Summer 2017-18

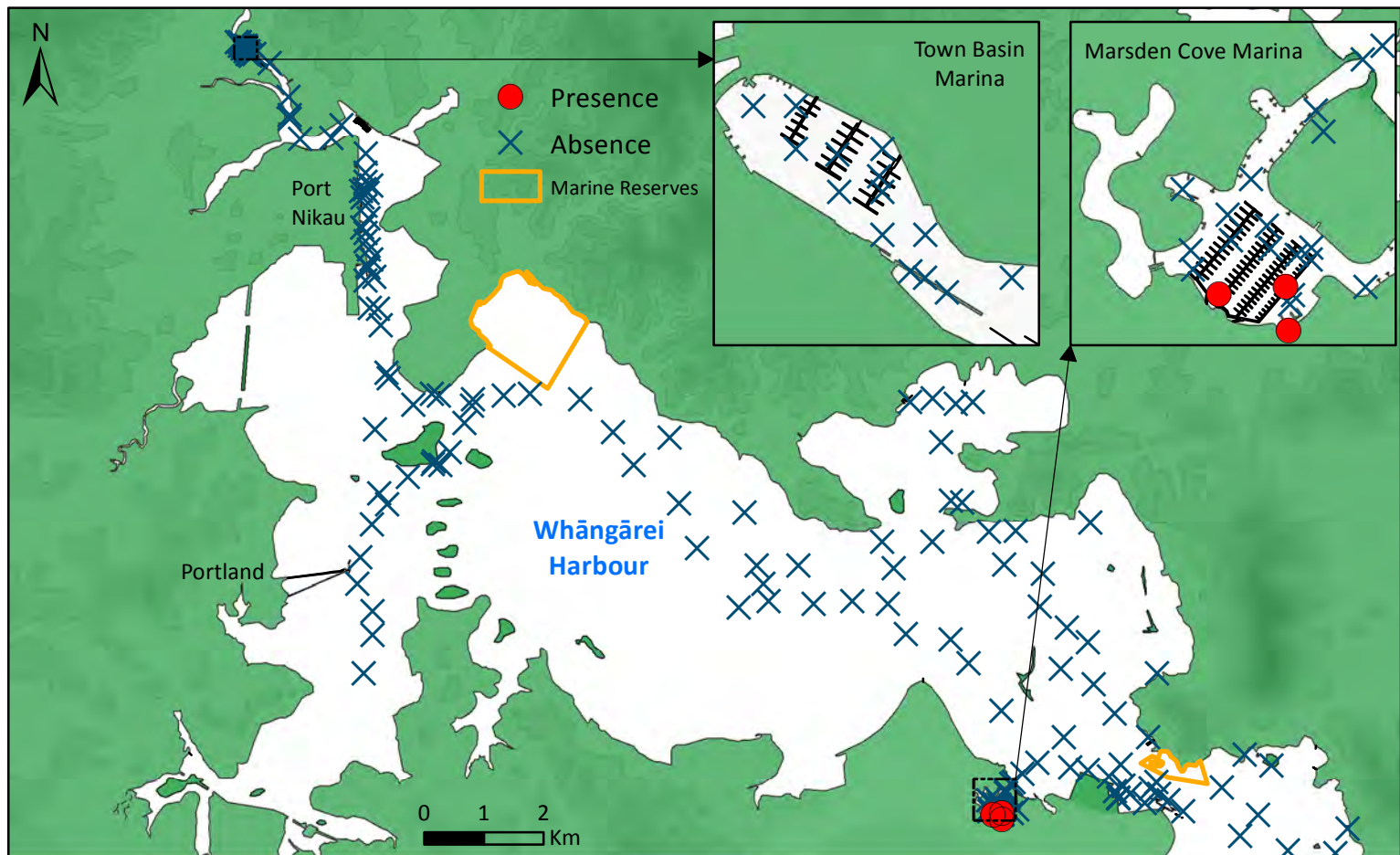
Pyromaia tuberculata



Whāngārei Harbour

Winter 2017

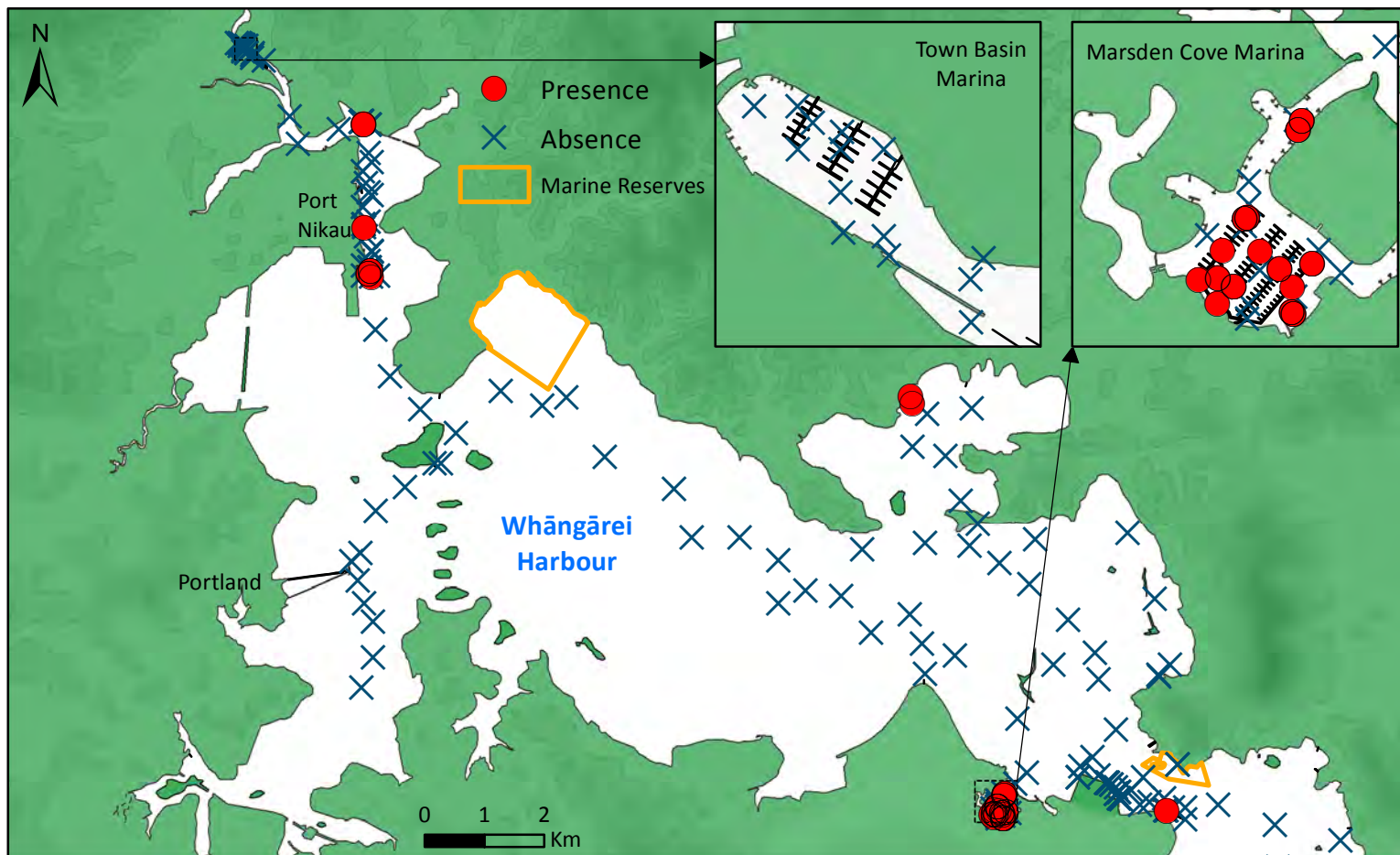
Sabella spallanzanii



Whāngārei Harbour

Summer 2017-18

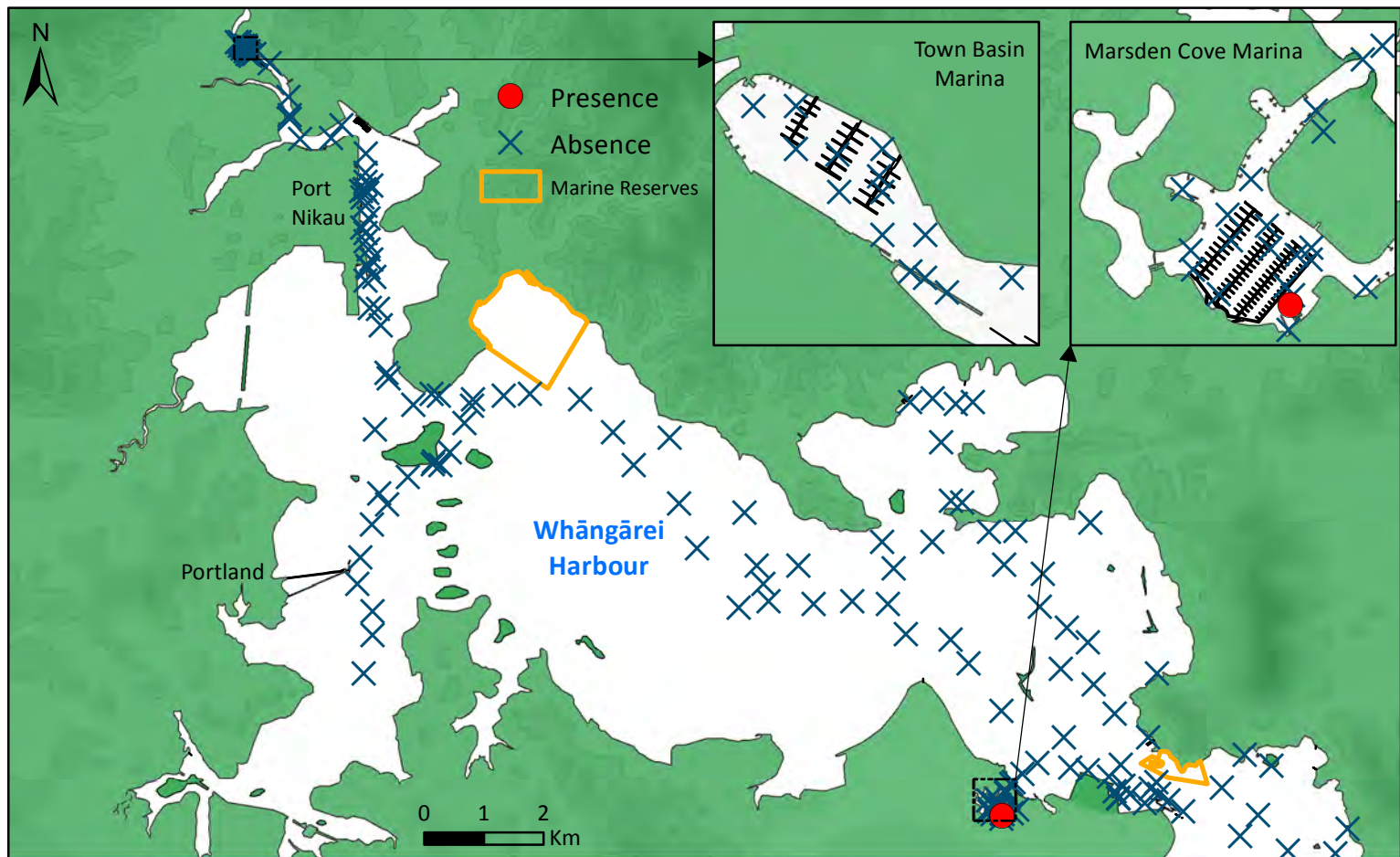
Sabella spallanzanii



Whāngārei Harbour

Winter 2017

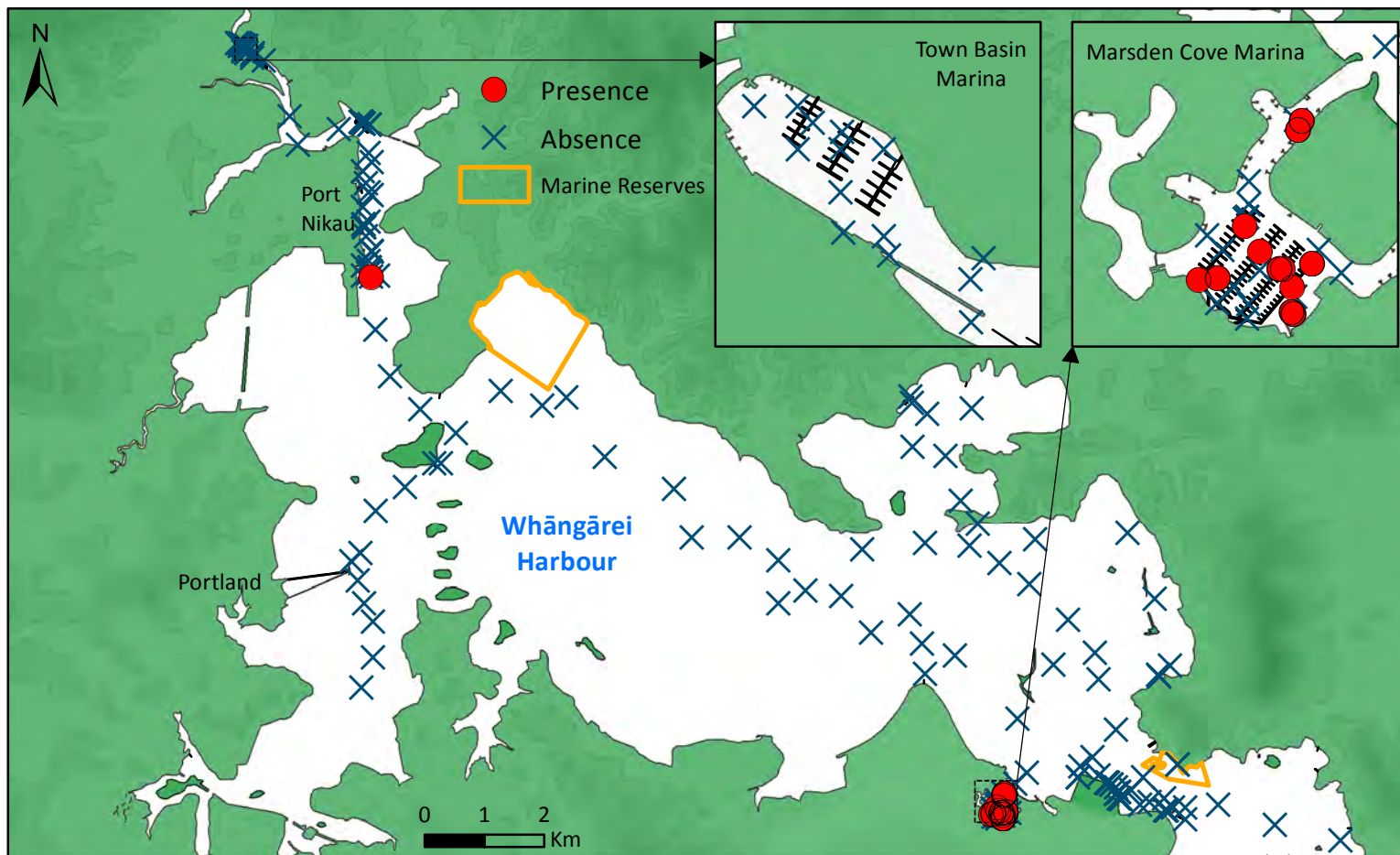
Styela clava



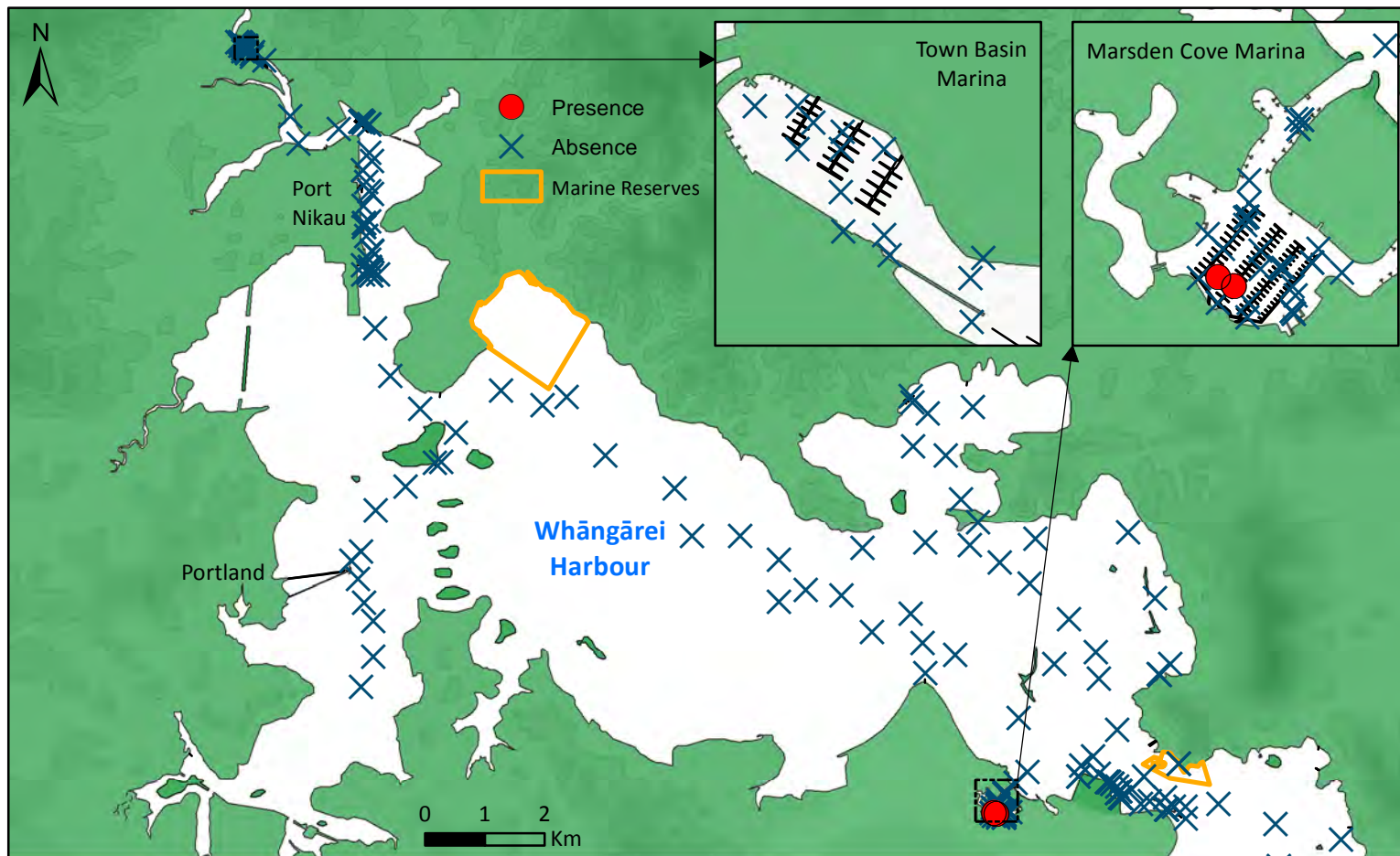
Whāngārei Harbour

Summer 2017-18

Styela clava



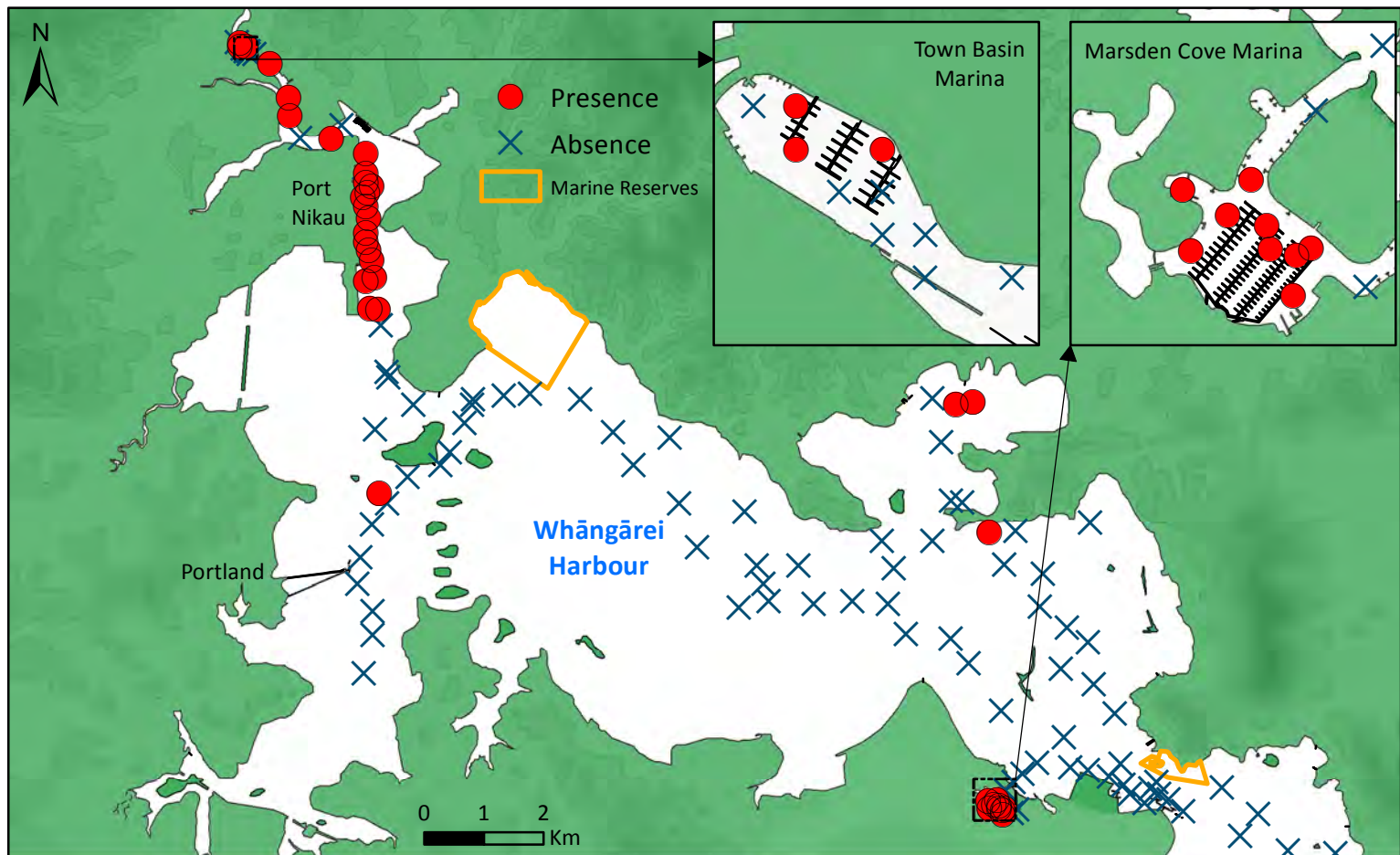
Whāngārei Harbour
Summer 2017-18
Symplegma brakenhielmi



Whāngārei Harbour

Winter 2017

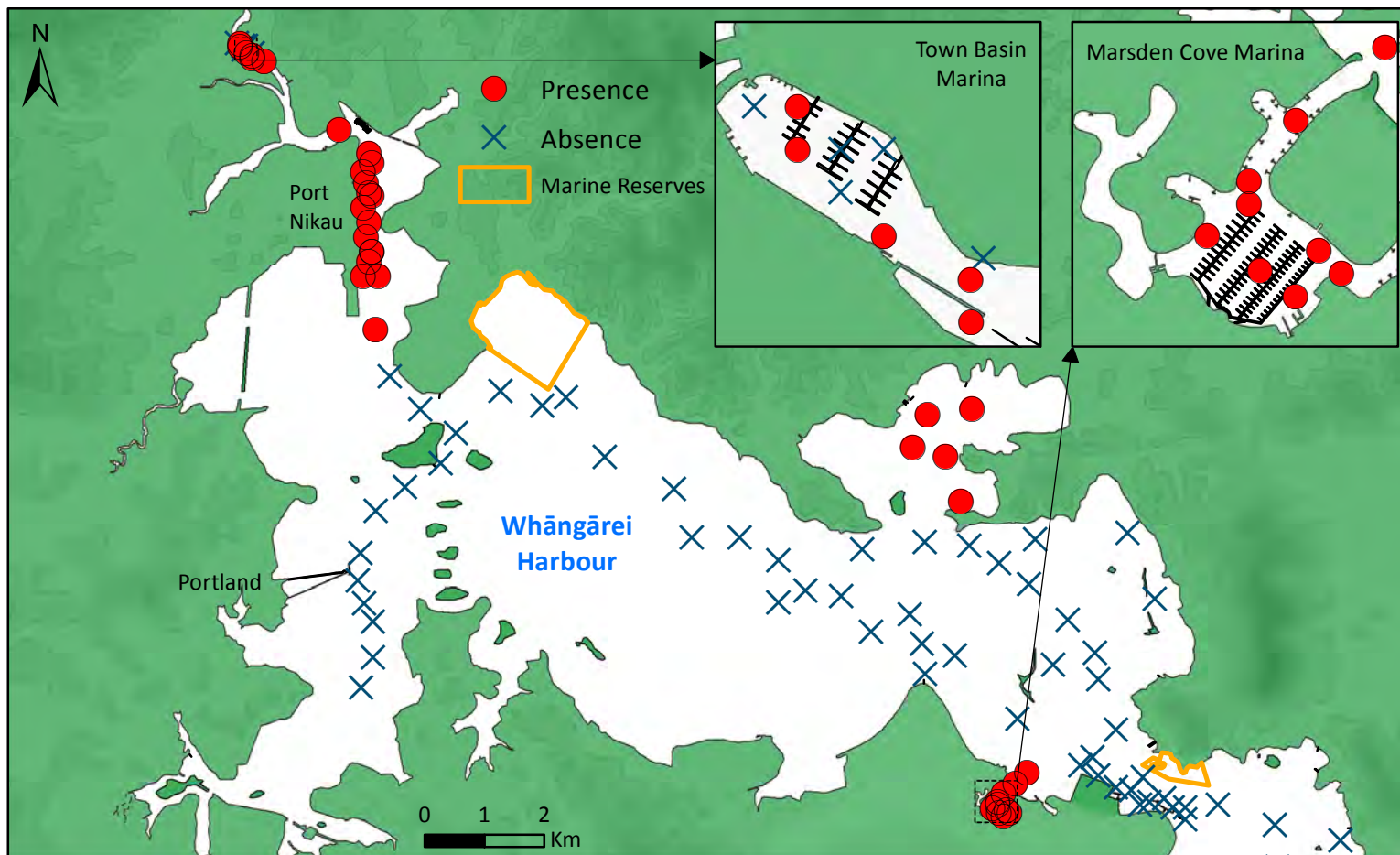
Theora lubrica



Whāngārei Harbour

Summer 2017-18

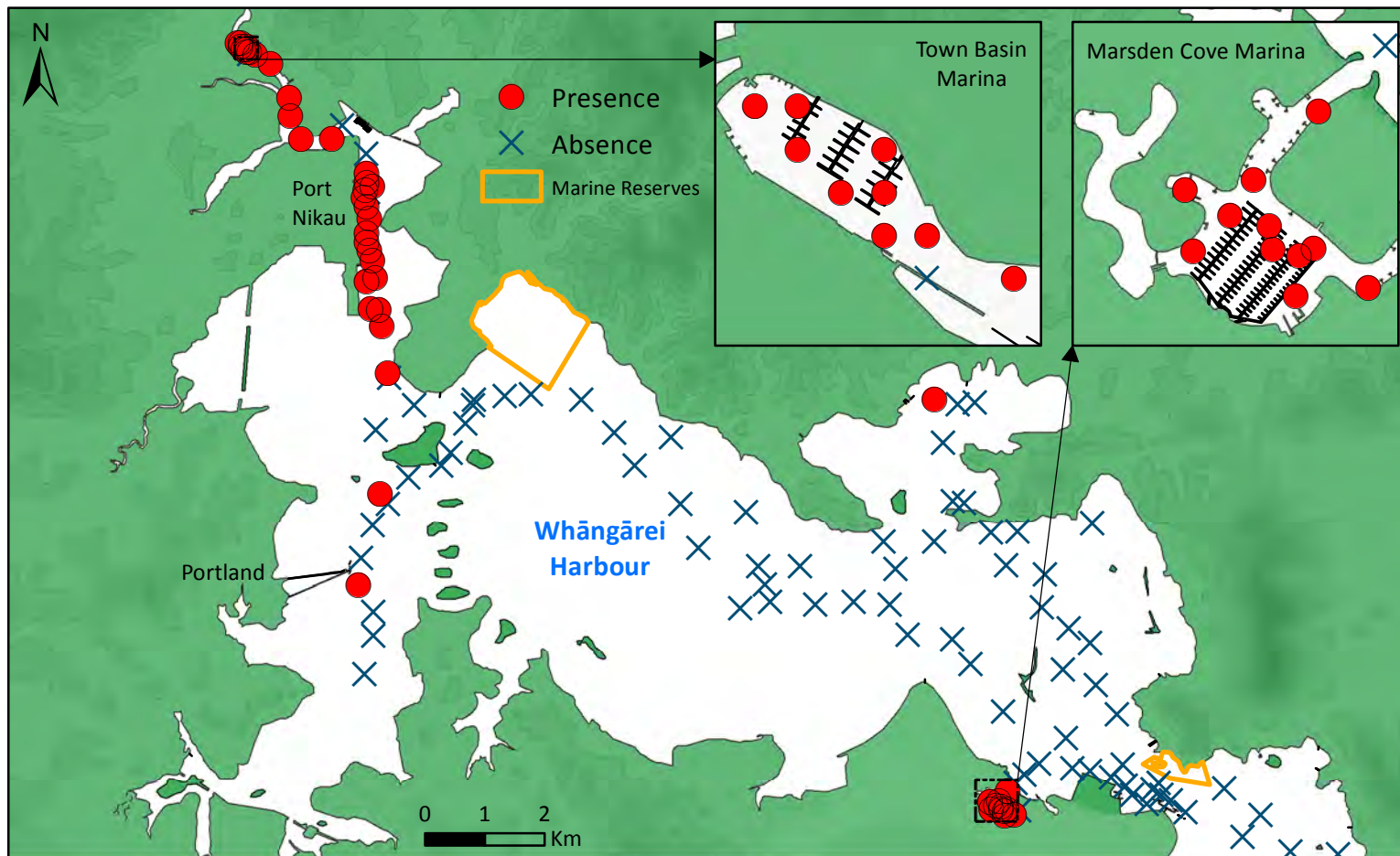
Theora lubrica



Whāngārei Harbour

Winter 2017

Tritia burchardi



Whāngārei Harbour

Summer 2017-18

Tritia burchardi

